QUANTAX

Energy-dispersive X-ray spectrometer
for electron microscopy

Quick Reference Guide

Innovation with Integrity

EDS

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We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections are included in subsequent editions. Suggestions for improvement are welcome.

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1 Introduction

QUANTAX is the ideal all-purpose energy dispersive microanalysis system for industry, research and education. Different system levels and various options are provided for scaling and tuning of QUANTAX to a broad range of analysis tasks and application environments. QUANTAX microanalysis systems are suitable for scanning electron microscopes, transmission electron microscopes, electron beam microprobes, dual beam devices, as well as other X-ray spectrometry applications.

All QUANTAX systems provide state-of-the-art qualitative and true standardless quantitative microanalysis for bulk specimens, polished samples, thin layers, particles, and rough surfaces. This is accomplished by optimized automatic or interactive spectrum analysis methods, fundamental parameter approaches (e.g. P/B-ZAF) and the most exact and comprehensive atomic database available. A standard-based PhiRhoZ quantification package is optionally available. The unique option of combining standard-based and standardless analysis methods complete the range of analytical possibilities.

An intuitive user interface, the flexible project management package, as well as various options for quick and comprehensive report generation complement the analysis toolboxes. The software tools are tailored to meet both the needs of the novice as well as the experienced user. All QUANTAX systems' ESPRIT software includes an online help system and support remote diagnosis and assistance via the Internet.

This quick reference manual provides a brief general software overview and a practical step-by-step description of the most common measuring procedures that can be performed with the QUANTAX system. A list of the main buttons, icons and controls is also included. For a complete description of the QUANTAX system as well as maintenance and safety provisions, please refer to the QUANTAX user manual. The integrated assistants and the online help of the ESPRIT software provide additional support. Details on the individual software and hardware parts and additional technical data are contained in separate manuals. The individual device manuals can also contain further references regarding operational safety. Please follow all safety instructions closely to avoid hazards to personal safety and equipment. In case of necessary maintenance, reinstallation, severe computer breakdown, hardware changes, etc. the Bruker customer support or your local supplier has to be contacted for further assistance and instructions.

According to the modular structure of QUANTAX not all parts of this manual may apply in detail to a given installation nor should be taken literally in all cases. For instance, where the general term "electron microscope" is written this applies to the whole class of electron-beam or dual-beam systems; SEM includes also STEM, microprobes, or other scanning devices. Also details of the program layout may vary according to the modules actually installed on your system and therefore differ slightly from what is shown in the illustrations and figures.

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Operation of the QUANTAX EDS microanalysis system is restricted to trained personnel familiar with the system as well as the product documentation, general safety precautions, and laboratory rules. A briefing on safety issues is given at the time of installation or during user training.

Local, state, or federal regulations have to be taken into account additionally to the safety instructions given here. Additional instructions for specific parts of the QUANTAX system - e.g. the X-ray detectors - may be contained in the according manuals.

The QUANTAX EDS microanalysis system may only be used in combination with electron microscopes or similar devices. Any other use beyond that is considered non-intended usage. The operator, not the manufacturer, assumes sole liability for all personal injury and material damage arising from non-intended usage.

2.1 Radiation Safety

⚠ DANGER

Changes to the original detector installation are strictly prohibited. Radiation safety may be impaired by improper installation or de-installation

The QUANTAX microanalysis system uses the X-radiation that is generated by the normal electron sample interaction in the electron microscope. Microscopes are generally designed to shield this type of radiation sufficiently.

The QUANTAX detector is installed according to the applicable radiation safety regulations. Changes to the original installation and equipment, including flanges, vacuum sealing, support, etc. are strictly prohibited.

In case the QUANTAX detector has to be uninstalled make sure that the **original blind flange** of the electron microscope vendor is used to seal the sample chamber port. In case the original flange is not available contact the microscope vendor for support.

2.2 Beryllium

⚠ DANGER

Beryllium is highly toxic!

If a beryllium window is destroyed despite all caution, absolutely all fragments must be carefully collected and disposed of according to regulations.

Beryllium safety issues apply only to X-ray detectors with beryllium X-ray entrance windows. Low energy windows do not contain toxic substances.

Beryllium is toxic if parts are inhaled or swallowed. With X-ray detectors, however, this is only possible in the rare case of a window breaking. Special care must be taken with XFlash® Detectors, as they do not contain enough vacuum to suck in the remains of a broken window, as a UHV-Dewar normally does.

In case of an accidental destruction of a beryllium window, gather all fragments thoroughly and collect them using pieces of adhesive tape. The waste has to be labeled and disposed of according to the local safety hazard regulations. Wear a filter mask during cleaning up.

2.3 Electrical Safety

⚠ DANGER

High voltage inside. Do not remove covers.

All parts have been designed according to the safety requirements for electrical equipment for measurement, control and laboratory use, or the European Low Voltage Directive, respectively. The system must be correctly installed and used only for the purposes it is designed for. Especially grounding of the system or system parts - as performed during installation - must not be changed for any reason. In case of any supplements or replacement parts being installed, supply voltage settings must be checked and adjusted to the local mains voltage.

Certain parts of the system may contain dangerous voltages. No covers need to be removed during regular operation; maintenance should only be carried out by trained and certified personnel.

2.4 Electromagnetic Compatibility

Due to its physical construction, the highly sensitive X-ray detector may not fully comply with common standards regarding electromagnetic immunity of general electronic equipment. This is not a disadvantage under normal circumstances because the QUANTAX system works under the same conditions as electron microscopes and the laboratory environment is designed to meet the requirements of these instruments.

Bruker devices fulfill all requirements regarding active electromagnetic compatibility (emission rules).

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3.1 Start-up and Login

The **ESPRIT** software runs on the QUANTAX server and the client workstations. However the user only has to start the client application; the server software and communication drivers will start and log in automatically.

A desktop icon and an entry in the Start menu serve for starting ESPRIT. A username and password are required for logging in. With multiple client installations a user can log in from any client workstation and access his private data and user profile on the QUANTAX server. With multiple QUANTAX servers in the network, the server to connect to is selected during log in procedure. A list of available servers is provided below the password entry box.

☞ System functions, especially concerning the measurement system (e.g. calibrations) will affect subsequent users. It is advised to exercise special caution here.

Multi-user systems. On multi-user systems several users can access, manage, and evaluate private and shared data simultaneously. The first user to start a measurement will gain access to the spectrometer and imaging system. This user will be able to perform measurements from the remote workstation. The access to the acquisition hardware remains locked to others as long as this user is logged in.

3.2 Main menu

The screen area on the left-hand side of the QUANTAX program window displays the main menu in form of buttons for selecting a workspace (the contents of the main program area) or important tools. In full screen mode the main menu is displayed as a line at the top of the program window.

QUANTAX Menu Tree

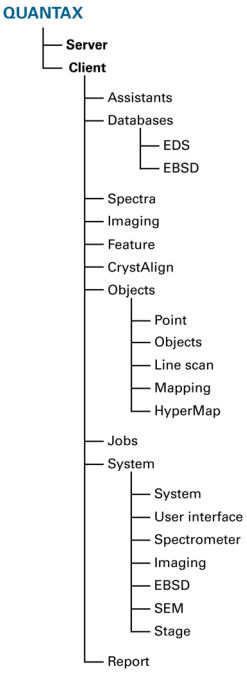


Fig. 3.2-1 ESPRIT menu tree

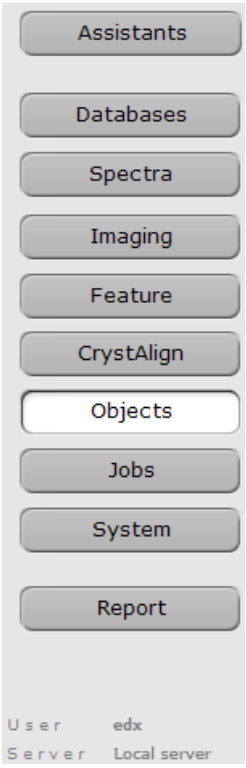


Fig. 3.2-2 ESPRIT main menu area

Assistants

provides guidance through a range of common analysis procedures.

Databases

EDS allows the administration of standard libraries in connection with standard based EDS analysis. In this workspace new standards can be measured and standard samples assigned to chemical elements. (In ESPRIT version 1.9 **Databases** / **EDS** replaces the main menu item **Standards**; the functionality remains the same.) **EBSD** contains relevant databases for electron backscattered diffraction. Refer to the QUANTAX CrystAlign documentation for details.

Spectra

provides acquisition and analysis of X-ray spectra without electron beam control. This workspace is also suitable for analyzing saved spectra.

Imaging

provides electron beam image capture independent of X-ray spectrometry. Imaging with QUANTAX is useful to upgrade older analog electron microscopes with digital image capture features. The workspace **Imaging** also provides basic image processing tools and is used to view saved images.

Feature

provides extensive feature (particle) analysis and chemical classification tools. Refer to the ESPRIT Feature manual for details.

CrystAlign

gives access to the fully integrated EBSD (electron backscattered diffraction) package QUANTAX CrystAlign. Refer to the CrystAlign manual for details.

Objects

consists of a group of workspaces that combine electron beam scanning with X-ray spectrometry. **Point** (MultiPoint) allows analysis of one or more points with electron beam control. Analyze arbitrarily shaped objects under **MulitPoint**. Perform

qualitative or quantitative line scans under **Line scan**. **Mapping** allows you to generate qualitative or quantitative element maps. **HyperMap** is Bruker's position tagged spectrometry tool (spectral imaging). Mapping and HyperMap also include the phase analysis tool **AutoPhase**.

DANGER

Take special care when changing any parameters in the **System** group of workspaces, apart from those mentioned in the text. Not only do these changes affect all users of the QUANTAX system, they may influence measurement results. As a worst case scenario, entering wrong **Microscope** and **Stage** parameters may damage especially older electron microscopes.

Jobs

is the workspace for configuring ESPRIT's powerful analysis automation tool and running unattended fully automatic analysis tasks.

System

comprises all maintenance and service panels for system set-up, calibration, license administration, and other. The **System** workspace is actually only required for installing a new license file if a software upgrade has been purchased. Everything else is set during system installation and should not be changed. **Display** can be used to change the language and the font size of labels and element markers as well as for configuring the list of forbidden elements for the element finder . **Spectrometer** is used for the energy calibration of the currently selected spectrometer. **Imaging** is used for calibrating the QUANTAX image magnification. **Microscope** and **Stage** contain basic setup parameters for electron microscope and motorized sample stage. These are defined during the installation of the QUANTAX system. Do not change unless specifically authorized by Bruker customer support.

Report

starts the QUANTAX Report editor that can be used in parallel to all workspaces that provide measurement data acquisition and processing (Spectra, Imaging, Feature, EBSD, Objects, Jobs).

3.3 Workspaces

The different workspaces mentioned above provide all necessary tools for spectra and image acquisition and analysis. Arbitrary changing between workspaces can be done without data loss; however running measurements will be terminated. A warning is issued before termination.

> ☞ Should one of the program areas be invisible, it is probably just covered up by an adjacent screen area. Just drag the strip line to resize areas.

Title bar. The title bar at the top of the ESPRIT program window contains the general control buttons common to Windows applications. Please note that the icon in the title bar closes ESPRIT completely not just the active workspace. The icon invokes the online help system, minimizes the program window and the and icons toggle fullscreen mode on and off.

Fig. 3.3-1 Screen area Devices

Devices area. The area **Devices** contains a line for each assigned X-ray spectrometer plus a line for the imaging system and general electron microscope settings and one for the EBSD camera. The lines display information on key parameters and the condition of the corresponding devices. Clicking one of the triangles to the right of a device name opens a panel for setting device parameters. The colored status signals left of the text lines inform on the device status (check the online manual for details).

Clicking onto a spectrometer data line will select this spectrometer for subsequent spectrum acquisition. The selection is highlighted in yellow.

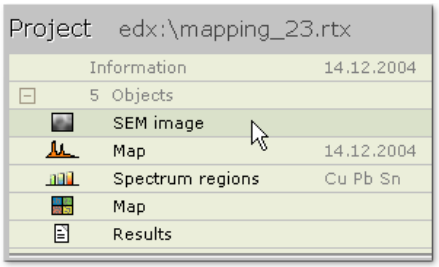


Fig. 3.3-2 Screen area Project

Project area. The **Project** screen area gives access to the content of the current project. The current project is maintained through all workspaces; it can be built up during one or more work sessions and later be saved to a file. The project area can also just serve as a permanent clipboard.

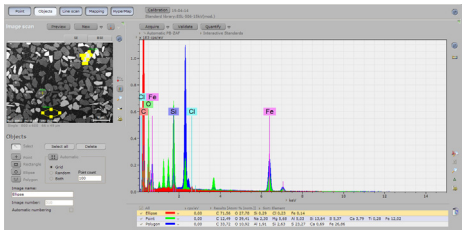


Fig. 3.3-3 A QUANTAX workspace

Measurement and analysis area - workspaces. This screen area contains the different acquisition and result windows, as well as all control elements for the measuring tasks combined to task-specific workspaces. The screen layout varies between different workspaces.

3.4 Display and Control Elements

Image capture window. Workspaces of the **Objects** group and the workspace **Imaging** have a dedicated area for controlling the electron image capture. Analysis spots, objects, scan lines, and mapping areas can be defined in the captured image. Image capture is controlled directly from the workspace. Additionally, a special window for fast image preview is provided.

One or two of the image detectors (typically the SE and BSE detector) can be connected to the QUANTAX hardware and selected for image capture with QUANTAX.

☞ In some cases the image detector selection on the microscope console also sets the QUANTAX image source.

Spectrum and Result window. Acquired spectra and result diagrams or element images share a common screen area in a workspace. The spectrum window provides multiple spectrum display and graphical spectrum comparison. Spectrum preview (before acquisition) is also available. In contrast to image preview, which is provided by a separate panel, the preview spectrum is displayed in the original spectrum window.

A list of spectra displayed below the spectrum window provides control over display, data exchange, and spectrum analysis.

Control buttons. A row of control buttons on top of the main display window. The buttons allow starting and stopping of preview, image capture, spectrum acquisition, automatic and manual spectrum analysis, and - in special cases - validating standard samples and reference measurements.

Option panels. A number of individual option panels and control buttons associated to the display windows are provided. These can be opened by clicking onto the icons on the right of the according windows (usually contain display options, but also tools) or the triangles ▽ next to the control buttons (acquisition and analysis options). Also, a number of text icons can be clicked to get access to option panels, settings, and selection boxes. In many cases diagram axis descriptions and column titles can be clicked to toggle selections. Active screen items are indicated with small ▸ triangles; active items will react when the mouse cursor is moved across them.

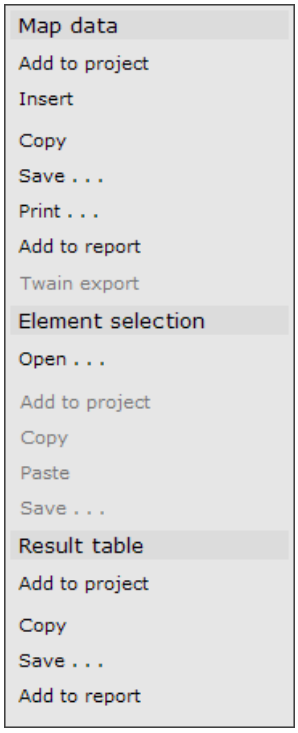


Fig. 3.4-1The mapping workspace Import/Export menu as an example

Clicking into data lists and thumbnail images results in highlighting them. Highlighted items can be selected for different actions, e.g. export to file or spectrum evaluation. In some cases multiple objects can be selected to perform batch processing.

Import/Export menu. The most important option panels are the individual Import/Export menus (symbols) that are available for separate screen areas and in many pop-up dialogs. The Import/Export menus contain context dependent subsections with options for saving and loading or importing and exporting spectra, diagrams, images, result lists, and other items. Import/Export menus control data transfer to and from the current project as well as to **Jobs** and to and from **Report**. Direct printing and on screen result checking is also provided through an Import/Export menu.

3.5 Analysis Options

Standardless spectrum analysis. QUANTAX provides advanced true standardless spectrum analysis based on the P/B-ZAF method. The self-calibrating P/B-ZAF analysis provides absolute (not normalized) results without standardizing or reference measurement and is optimally suited for remote spectrum analysis. ESPRIT attaches all the necessary analysis data automatically to the spectra, making QUANTAX spectra completely self-contained.

The P/B-ZAF routine is extraordinarily tolerant to varying acquisition conditions and sample states (e.g. rough surfaces), yielding useful quantitative results even with unprepared samples.

Standardless analysis is also provided for fully quantitative line scan and element mapping.

Standard-based analysis. Standard-based analysis is provided on the basis of the P/B-ZAF and PhiRhoZ matrix correction.

Performing standard-based P/B-ZAF analysis is as easy as a simple click in the method editor (or

selecting a predefined Method), provided that a suitable standard library is at hand.

PhiRhoZ standard-based analysis additionally requires system calibration, however administration and data handling are also here completely automatic.

QUANTAX includes a comprehensive library manager that allows easy build-up and maintenance of multiple user related libraries for standard-based analysis. This provides most accurate results for any analytical task, as a special standard library for the purpose can be maintained.

The use of the standard library installed on your QUANTAX system at delivery time for other than test purposes is discouraged. It is included for educational reasons. As it is not specially adapted to the measurement conditions of your QUANTAX, it will yield results that are inferior to those of the standardless P/B-ZAF method.

Reference-based analysis. QUANTAX reference-based analysis is most straightforward and controlled directly from the workspace. Reference measurements are stored in the spectrum list together with the spectra of the unknown sample. Current references will replace the assignment of standards from a standard library on an element-by-element basis by default allowing mixed referencing.

Combined standardless and standard-based analysis. Combined analysis is no extra option but automatically included within the ESPRIT standard-based analysis tool. It is provided in connection with P/B-ZAF as well as PhiRhoZ matrix correction.

During interactive spectrum evaluation the default standard assignment for all selected chemical elements can be changed by the user, i.e. there is always the choice between current references, any suitable standard sample from the library or true standardless analysis on an element-by-element basis.

If a standard or reference is unavailable, e.g. in case of rare chemical elements, ESPRIT automatically uses standardless analyses for these elements.

Automatic and interactive spectrum analysis. QUANTAX performs automatic spectrum analysis during or after spectrum acquisition and supports

batch processing for multiple spectra. The whole acquisition and analysis process can even be fully automated using the powerful automation tool Jobs, see section 3.6 below.

Interactive spectrum analysis, which gives full control over all critical spectrum analysis steps, is provided for in-depth examination of special samples.

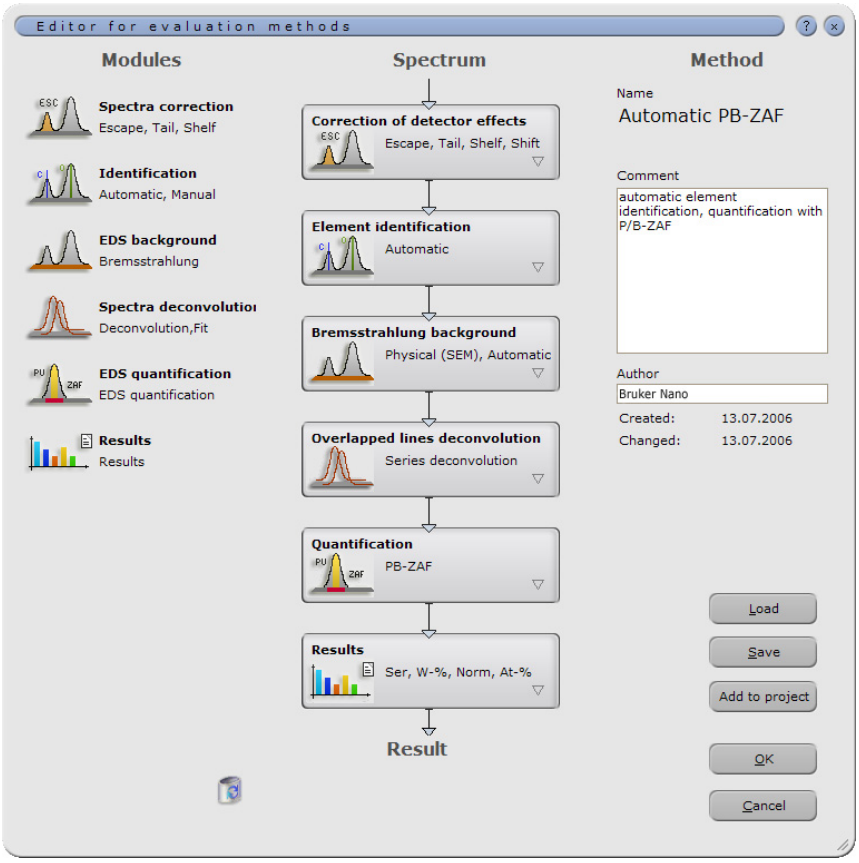


Fig. 3.5-1 The ESPRIT method editor for spectra evaluation

Method editor. Customized analysis strategies (so-called Methods) can be configured for repeated use or routine analysis. The method editor provides control over all analysis steps, including identification, peak devconvolution and quantification strategies. A number of predefined methods for common tasks are included with the ESPRIT software.

Line scan and mapping. **Line scan** and **Mapping** is provided with fast, accelerated, or fully quantitative spectrum analysis. With fast analysis mapping full control over the scanning process is possible. This ranges from slow-scanning single frame capture over line averaging to high speed frame averaging modes for noise suppression.

The **HyperMap** function, which records a full spectrum at every point of the map, is optionally available. This method is also known as position-tagged spectrometry or spectral imaging. HyperMap stores all data in a hyperspectral database, which is the basis for evaluation at any time during or after acquisition. This has the advantage that all kinds of measurements can be performed on this data, including point measurements, line scans and qualitative and quantitative maps, as well as phase analyses. The disadvantage is that the databases require enormous amounts of storage space, which currently makes HyperMaps beyond 1024 x 768 pixels resolution difficult to manage.

ESPRIT maintains separate presets for electron image capture, mapping, and line scans.

Element Imaging. Setting up of element images is provided as a post process of element mapping. Different image mixing modes are provided, equipped with full control over contrast and brightness settings as well as color contributions of the individual element maps. Settings can also be altered and optimized during the scan process.

ColorScan. This tool can be accessed from any workspace with imaging function.

AutoPhase. ESPRIT AutoPhase results can be accessed from both **Mapping** and **HyperMap** workspaces through the **Phases** tab. AutoPhase itself is invoked through the according command button in these workspaces.

AutoPhase determines phase content in mapping images based on a range of different user selectable methods. These include histogram based methods (automatic binning and principle components analysis), clustering and analysis based on predefined objects drawn in the mapping images by the user. A set of controls is provided to fine-tune phase analysis through adjustment of overall sensitivity, minimum phase area and edge resolution.

3.6 Analysis Automation

ESPRIT includes the powerful automation tool **Jobs**, which is accessible through its own main menu entry. **Jobs** allows unattended acquisition and evaluation of images and spectra, including control of the microscope stage. In fact most of the analytical

tasks that can be performed with ESPRIT can be automated using this feature.

Jobs performs an automatic analysis run by processing all analysis tasks – called jobs – in a job list. The job list is filled either by defining jobs in the according workspaces or by creating them with **New jobs**. It is recommended to use the workspace functions, e.g. in setting up a mapping, and then adding the job to the list using the group level Import/Export menu.

It is highly recommended to use automatic acquisition and analysis; otherwise the "automated" run will not be free from user interaction at all. Nevertheless, should you choose to add interactive steps, **Jobs** will issue an according warning, when the run is started. If you continue, **Jobs** will stop at every point where user interaction is required and wait for actions. This can be very tedious in case of multiple manual spectra or image acquisitions.

If you create a job within the workspace, it will be performed at the current stage position. If you create it as a new job in **Jobs**, this will invoke a dialog for stage data setup. For a description see next subsection 3.6.1.

Available types of jobs include:

- Spectra measurement
- Image scan
- Objects measurement
- Mapping (qualitative, quantitative and HyperMap)
- Feature analysis
- System jobs

Feature analysis jobs are described in the ESPRIT Feature user manual. System jobs include those for stage moves (**Stage move** and **Finalization**) and adding a **Result table** to the output.

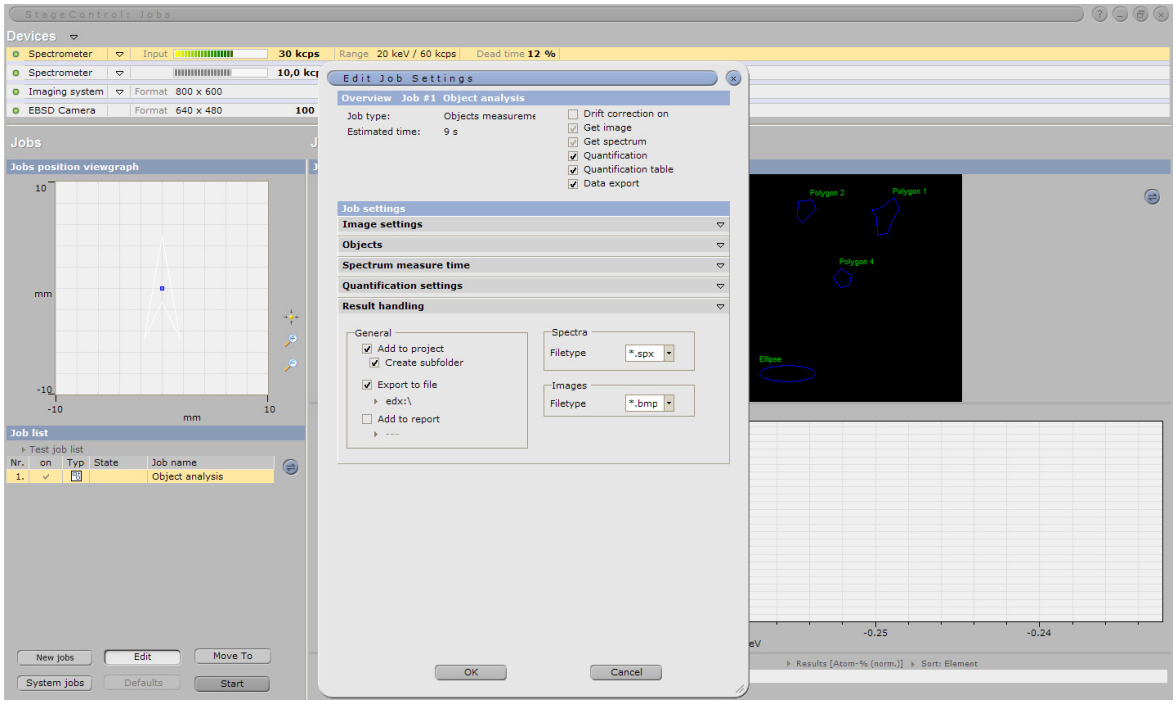


Fig. 3.6-1 The Jobs workspace with job editor open

3.6.1 Setting up Jobs and Stage Positions

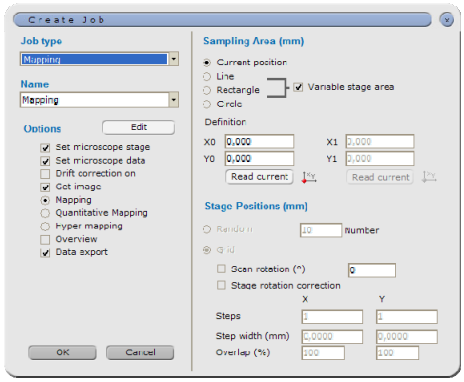


Fig. 3.6-2 The dialog for creating a new job

New jobs can be created either from scratch with **New jobs** or by first highlighting an existing job and then clicking **New jobs**. In the latter case the highlighted job will be used as a master and the new job(s) will be one or more duplicates. What is explained here applies to both cases.

General options. The exact type and number of parameters depend on the type of job. Most of them are self-explanatory. The common general options are: **Name** assigns the job a name. Although this field contains a default preset and a selection by drop down list, it is advisable to assign unique names to jobs in order to facilitate later review of results, especially when processing long job lists. **Drift correction on** enables image drift correction. **Get image** acquires an image at the job position (enabled by default for all jobs that include image acquisition by nature: image scan, objects measurement and mapping).In contrast **Get spectrum** is activated for spectra and objects measurement jobs. Mapping type is a radio button list that can be set to **Mapping**, **Quantitative mapping** and **Hyper mapping**. In case of spectra or objects analysis you can also define whether **Quantification** should take place and whether a **Quantification table** should be added to the output data. The quantification table collects all quantitative results from jobs where the according option was selected. This quantification table can be saved separately or exported to Excel. **Data export**

adds all analysis results to the project, depending on the type of job.

Sampling area. One of the most important settings for automated analysis is where to measure. **Jobs** offers very flexible options for setting up measurement positions. The whole right hand side of the Create Job dialog is dedicated to this task. First of all, you can choose to measure at the **Current position** (this is what happens automatically, if you generate the job in one of the analysis workspaces).

Additionally, it is possible to move the stage manually and click **Read current** to update the system. All other options are intended for screening a sample area. You may choose to define a **Line**, **Rectangle** or **Circle**. In these cases, you have the choice of activating **Variable stage area**. Simply put, this rather abstract concept means that the actual analyzed area is not fixed but depends on the number of grid points, the microscope magnification and the overlap of selected fields of view (see subsection Stage positions below). In this case the current position will be used as a start point for the screening. Without variable stage area, you will have to enter coordinates **X0**, **Y0**, **X1**, **Y1** to define start and end points. Alternatively you can make manual stage moves and read the current position at both locations. In case of **Circle** these two points define the diameter of a circle to be drawn around the center of that line.

Stage positions. The parameters to be set here complement those under **Sample area** directly, apart from **Current position** where they have no effect. You can either choose **Random** subdivisions of the line, rectangle or circle or define a **Grid**. In the first case you will just have to enter a number of fields of view to be measured and Jobs will randomly position them within the object coordinates. In the majority of cases the **Grid** option will make more sense. You simply have to define the number of subdivisions in X and Y-direction and ESPRIT will automatically calculate grid points and step sizes and overlap in both directions for you. It also works the other way round; defining **Step width**s will calculate the number of grid points and overlap. Changing the **Overlap** will result in the step sizes and number of grid points being calculated.

If you have chosen Line, Rectangle or Circle as sample areas, a separate job will be generated for every grid point and added to the job list, once you

have clicked OK. These jobs are identical except for their names (that contain their grid position index in brackets, apart from what you have assigned) and the stage positions associated to them. Note that length of the job list rises considerably with the number of grid points.

3.6.2 Editing Job properties

Jobs can be edited using the job editor, accessible by highlighting the desired job with the mouse and clicking the Edit button below the job list. The available options in the job editor dialog depend on the type of job; this means not every option described here will apply to every job. The parameters that can be set are in most cases the same as for manual performance of the according measurement task. They are grouped as described below. The parameters of a group can be accessed by activating a drop down with a click on ▽ on the right of the group name. A second click on ▽ will close the drop down again. If you have used the **Add Job** dialog in an analysis workspace, many parameters will already have values assigned, this is the place to make changes.

General options. The general options for a job are already set during job creation. These options vary according to the type of job defined. A commonality is that they can be edited directly in the **Job data** section next to the position viewgraph or at the top of the job editor dialog. See also section 3.6.1. above.

Image settings. Use this group of parameters to set image source, resolution, dwell time and averaging conditions. You can also decide whether an image legend is added and what is contained in that legend.

Objects. This group of parameters varies depending on the type of job. In case of mapping you can manipulate the area to be mapped using a preview image. In case of objects measurement you can rearrange, add or delete objects to be analyzed.

Map settings. Use map settings to set up the acquisition mode and time. Be sure to choose a mode that automatically terminates acquisition, **Cycles** or **Real time**. You can also decide whether the map image includes a legend and change the selection of elements to be mapped.

QMap settings. Here you can set the **QMap resolution** as a fraction of the fast map size, select **Interlaced measurement** or **Fast quantification**.

Mapping filter. You can set up the visual appearance of the mixed element image by defining filtering options. You can also choose to process the electron image.

Spectrum measurement time. Here you can change the spectrum acquisition mode and time. Be sure to choose a mode that terminates automatically. This means you may choose any of the modes except **Manual**.

Quantification settings. You can choose the quantification method to be used in evaluating spectra. Again, only choose non-interactive methods! You may also set elements for identification based on **Line markers**. Customization of a method also works here as the **Method editor** is accessible through a click on the method name.

Result table options. This is only applicable when you have chosen to add a **System job** of the type **Result table**. You may then choose in what units the results are presented and whether quantification errors are displayed or not.

Result handling. What to do with the analysis results? By default they will be added to the current project in a new subfolder. You can also choose to export all results to separate files. If you activate this option, you will be prompted to choose a folder where the results will be written to. You can also set file types to use for spectra and images. It is also possible to add the results to a project. In this case you will have to choose an appropriate template from the template folder to use it as a master for the report. Should you not choose to store job data during the automated run, you may do so afterwards by using the Jobs Import/Export menu. Be aware that this alternative poses a certain risk of data loss, should the automated run fail.

Stage position. This applies only to system jobs of the type **Stage move**. Here you can enter position data and the microscope stage will be moved to that position during processing of the job list.

SEM data. This is another set of parameters that only applies to jobs of the type Stage move. Here you can set microscope parameters, like **Magnification**, **High voltage** and **Working distance**.

SEM optimization. Enable or disable **SEM Auto Contrast** / **Auto Brightness**, **Auto Focus** and **Auto stigmation** (if supported by the SEM).

Run at job list end. Steps to be performed at the end of the jobs list, like to **Switch HV off** or **Move stage to start position**.

3.7 Projects and Reports

3.7.1 Projects

Projects. **Project** is the name of a special screen area or a data structure that can file objects (spectra, images, data list...) generated during ESPRIT work sessions, except HyperMap, Feature analysis and EBSD.

The hierarchical tree structure of a project facilitates the grouping of data belonging together, e.g. spectra, result lists and associated sample images. The tree structure is organized automatically in the order objects are sent to the project via the Import/Export menus of the specific workspaces.

Objects saved in a Project can be retained including all primary data, relevant settings and attached information. Some of the ESPRIT objects can only be saved by embedding them in project files.

Loading and saving Projects. Projects are independent of work sessions: different projects can be used during the same session; incomplete projects can be continued in later sessions. Projects are saved to project files for permanent storage. Project files can be saved in private, public, local, or network areas and managed like any other data file, e.g. using the Windows® Explorer.

Data exchange. Objects embedded in a Project can be exported to a separate file, exchanged with a QUANTAX Report, and reloaded to the workspace. External data files - like additional text documents or photographic images - can be included in a project as well. This is useful for bundling various data regarding a work task.

3.7.2 Reports

ESPRIT reports (formatted result presentations) can be produced in two different ways:

External report. All objects to be included into a graphical or text report generated by a third party software tool, e.g. a page processor, can be transferred using files saved to local volumes, using the export function or via Windows clipboard. Both applications can run simultaneously allowing the report to be built-up during the course of work. Transferring data to third party applications with ESPRIT works with a few mouse clicks.

ESPRIT Reports. ESPRIT includes a WYSIWYG editor (report editor) very similar to well-known Office tools. However in contrast to these, the ESPRIT report editor features context sensitive templates, linked data tags and object specific placeholders (auto text, spectra fields, image fields, result list fields...).

These allow a great degree of automation of report generation. ESPRIT reports can be saved, retrieved, and distributed. The complete report can be exported to Microsoft® WORD.

Editable Objects. ESPRIT reports do not only contain graphics, but also editable data objects. These play the same role as objects in a project in the sense that the content can be re-edited, and processed at any time. Thus even spectra contained in a report and distributed to another location can be re-quantified. Almost all types of objects can be exchanged between the current project and an ESPRIT report.

Report templates. Report templates are of the same data type as ESPRIT Reports, i.e. they are as easy to design as a normal report. Existing reports can serve as or easily be converted into templates.

Predefined templates normally contain headers, company logos, etc. plus placeholders for the actual entries.

Different templates are maintained, associated to combined objects, line scans, and mappings, as well as simple print pages. ESPRIT default templates can be redesigned or changed using the familiar graphic tools of the report editor.

3.8 Volumes, Files and Folders

Volumes and Folders. Each user logged in to ESPRIT can access private and public volumes on the QUANTAX server. Private data is not visible to other users, on public volumes all users have the same rights so that any user can access, change, and delete any file or folder stored here.

Local drives of the client workstation and network drives (connections mapped to drive letters) can be accessed as well.

File formats. Additionally to proprietary data formats, a number of export or exchange formats are supported. Examples are common graphic formats like bmp, jpg, and png, EXCEL® formats, and EMSA/MSA spectra.

Proprietary file formats ensure complete data conservation including all secondary information attached to an object. Multiple data can be grouped in project files.

Graphic export. Typical EDS data like spectra and concentration profiles can be exported in form of data or graphic files. Graphics are equivalent to what is displayed on the screen. Graphic export is possible using common file types or the Windows® clipboard.

User Profile. User profiles are stored on the QUANTAX Server in form of hidden files. They contain system data and settings associated to the individual user. Besides various screen settings they also contain the current analysis methods selected or created by the user. Registered users are provided with their private settings independently from which client workstation they log in from.

3.9 The Help System

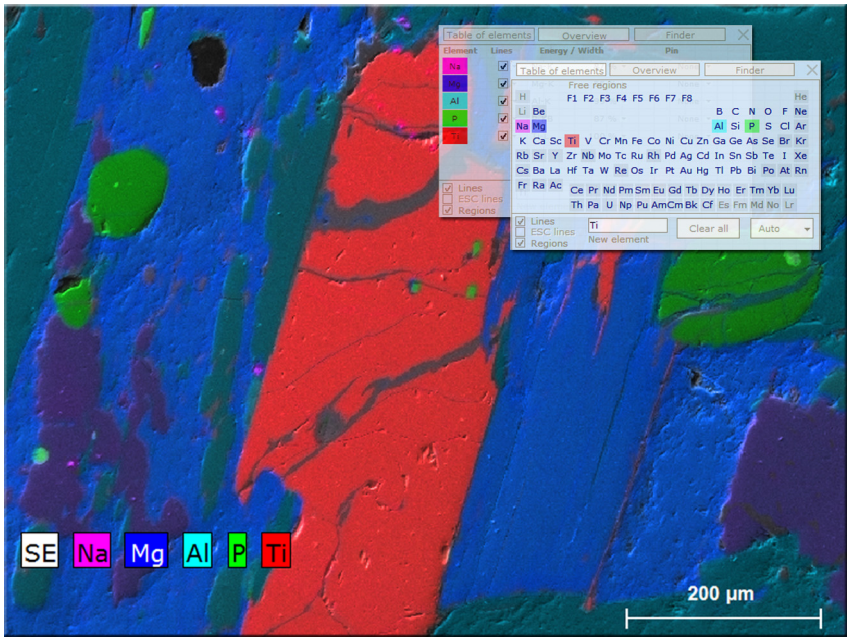
Online help system. ESPRIT features a multi-level help system. Descriptions are provided for all major control elements. In case of necessary actions or exceptional situations, dialog boxes and warnings are issued, preventing the user from performing unwanted actions.

Context sensitive help. Context sensitive help is available from the dialogs. The comprehensive and extensively linked online user manual and tutorial can be accessed from the program window.

On-screen guides. Dialogs or options that are not frequently required provide on-screen guidance directly from the workspace.

Assistants. The integrated assistants interactively guide through common analysis tasks. They provide step-by-step instructions ranging from sample preparation to creation of reports.

4 Software and Analysis Short Reference



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This section intends to give the analyst a quick overview of the most important tools of the ESPRIT software, so permitting a quick start into analyses with the QUANTAX EDS microanalysis system. In-depth discussion of specific functions and settings is left to the QUANTAX user manual. For ease and comfort of use the relevant sections of these manuals are referenced wherever necessary.

The procedures described here assume standard (default) ESPRIT settings. They also refer to the use of a scanning electron microscope or similar. Users of transmission electron microscopes may use this overview as well, but should exercise special care when it comes to microscope-specific operations, e.g. stage positioning, high voltage or working distance settings.

4.1 Preparatory Steps

	Step	**Examples/hints**
1	Prepare the sample for imaging and microanalysis	
2	Put the electron microscope into operation and adjust high voltage, magnification, and working distance designated for EDS analysis.	*High voltage 15 (20) kV* *Magnification 1000x* *WD as assigned for EDS*
3	Start ESPRIT and log in	
4	Reset or check system settings	*Image capture:* **Single** *Analysis methods:* **Automatic PB-ZAF.mtd** *Acquisition timing:* **Automatic**, **Precise** *or* **Manual** *Spectra display:* **cps/eV**, **keV** *Automatic analysis* **After Acquisition**
5	Check device functions, settings, and microscope data	*Parameters on QUANTAX screen must match microscope settings.* *Use automatic spectrometer settings.* *All status indicators for devices should show green*
6	Select workspace **Objects**, **Point**	*The* **Spectrum** *workspace can also be used for simple spectrometry tasks.*
7	Start spectrum preview and check spectrum	*Check energy calibration by setting line markers for known chemical elements. (Ref. 4.2)*
8	Adjust beam current according to the desired count rate and readjust image brightness and focus on the SEM if necessary	*Spectrum analysis :* *Si(Li): 1 ... 5 kcps* *XFlash: 5 ... 50 kcps* *Mapping:* *Count rate indicator green/red*

4.2 Energy-Channel Calibration

Correct energy-channel (or gain) calibration is a prerequisite for reliable qualitative and quantitative analysis results. Calibration should be checked from time to time (weekly) and adapted if necessary to compensate for spectrometer drift. Calibration should be performed always after switching the signal processing unit on. (Not required when using standby mode. Recommended!)

	Step	Examples/hints
1	Select **Spectrometer** workspace	*Do not mix up energy-channel calibration with system factor calibration (accessible through the Calibration buttons in every workspace that includes spectra acquisition). (Ref. 4.5)*
2	Move calibration sample into the analysis position and set beam current (spot size) to produce an intermediate count rate	*Any element in the mid energy range (Mn – Zn) in a given sample can be used, provided it is contained in a reasonable concentration. Preferably use single element standards (e.g. pure copper) to avoid peak misidentification, improve speed and accuracy.*
3	Select spectrometer ranges to be calibrated	
4	Select element and line for calibration	*Use Kα lines whenever possible*
5	Check accuracy and click **Start**	**Intermediate** *calibration accuracy is sufficient in most cases*
6	Click **Yes** to save new calibration data	*Note that the storage of calibration data is not user specific. Changes in calibration will also affect all users of the spectrometer.*

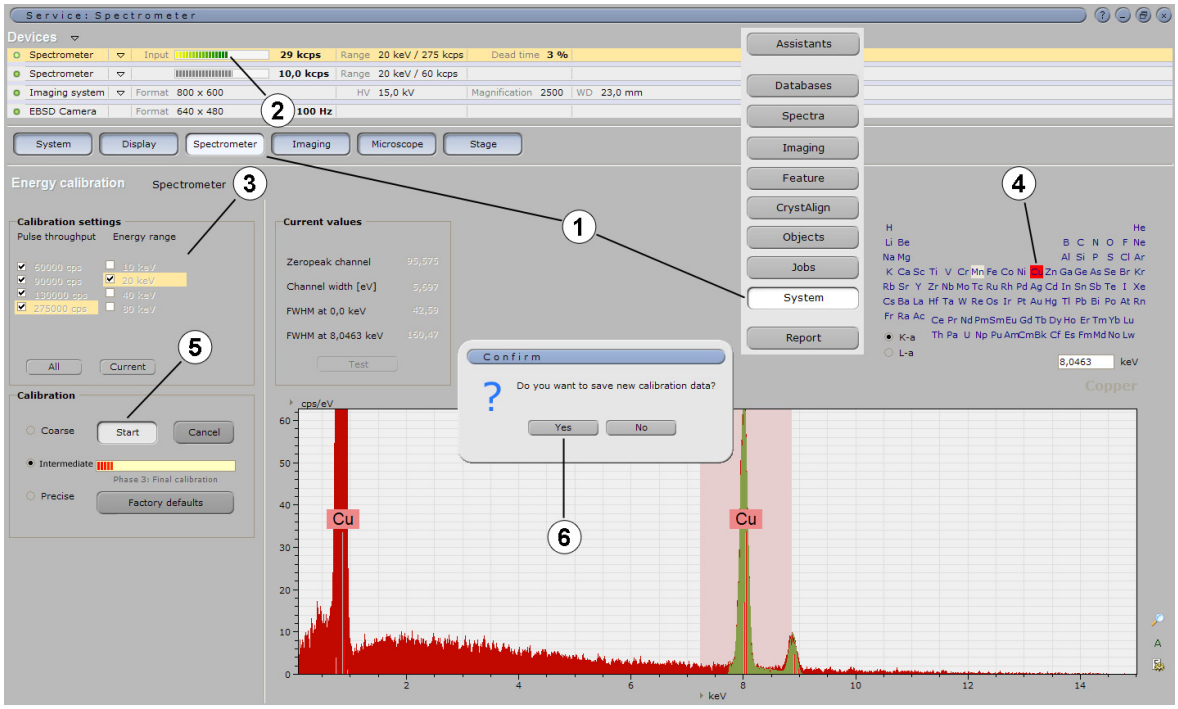

Fig. 4.2-1 Spectrometer calibration

4.3 Automatic Standardless Point Analysis

	Step	Examples/hints
1	Prepare sample and select workspace	*Workspaces* **Spectrum**, **Point** *or* **Objects**
2	Click **New** to acquire an image	
3	Adjust measurement point or sample position	
4	Click spectrum **Preview**	
5	Set element line markers	*Progress in the order from higher to lower peak energies*
6	Adjust beam current if necessary	*Use low to intermediate count rates for optimum results (count rate indicator yellow to green)*
7	Check if automatic analysis after measurement is selected	
8	Click **Acquire**	
9	Check results	

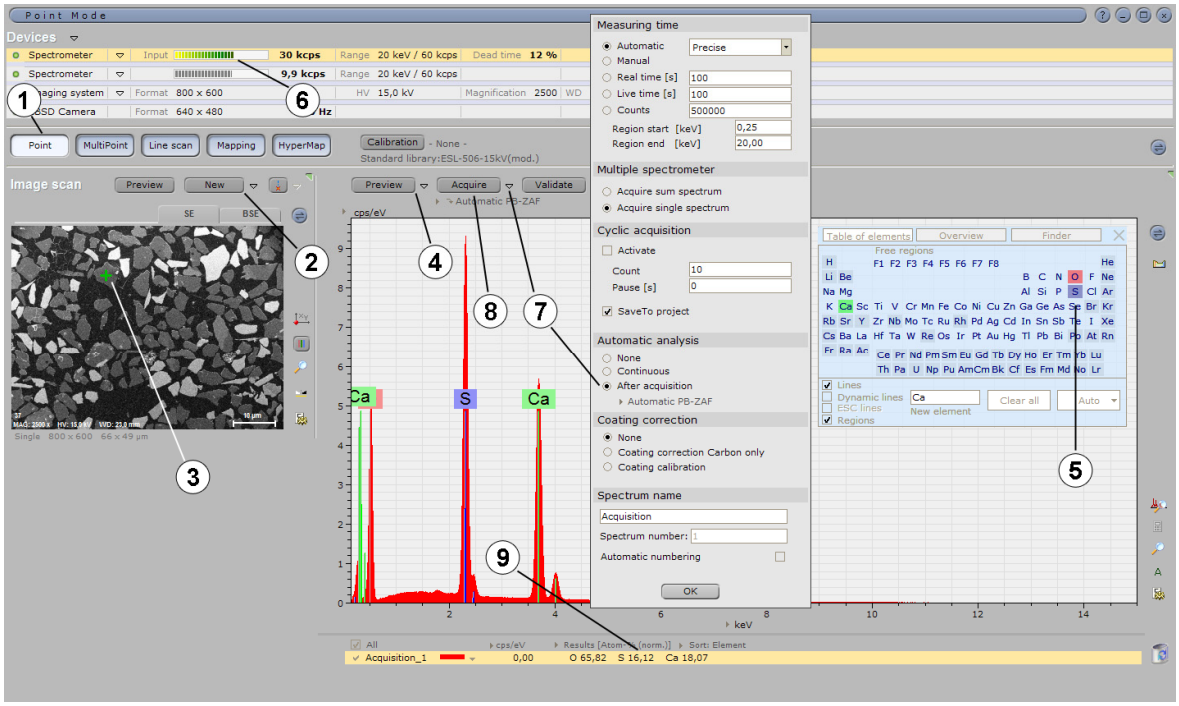

Fig. 4.3-1 Automatic standardless point analysis

4.4 Analysis with Direct Reference

	Step	Example/hints
1	Prepare unknown sample and reference. Select workspace	**Objects / Point** *or* **Spectrum**
2	Select standard-based method, disable automatic spectrum analysis	*e.g.:* **Interactive Standards.mtd**
3	Bring reference into analysis position and adjust microscope parameters	*For precise analysis use low to medium electron beam currents (yellow to green area)*
4	Click **Acquire** to acquire spectrum	
5	Click **Validate** and enter the known element concentrations for the reference	*If an interactive quantification method was selected, element identification and background fitting will have to be performed before entering element concentrations. Finally, confirm the element assignment for all chemical elements that shall be quantified according to that reference*
6	Bring the unknown sample into analysis position and click **Acquire**	*Don't change any relevant microscope settings (beam current, focus, high voltage ...)*
7	Click **Quantify**	
8	Check results	*Elements quantified according to the reference will be denoted by two asterisks **.*

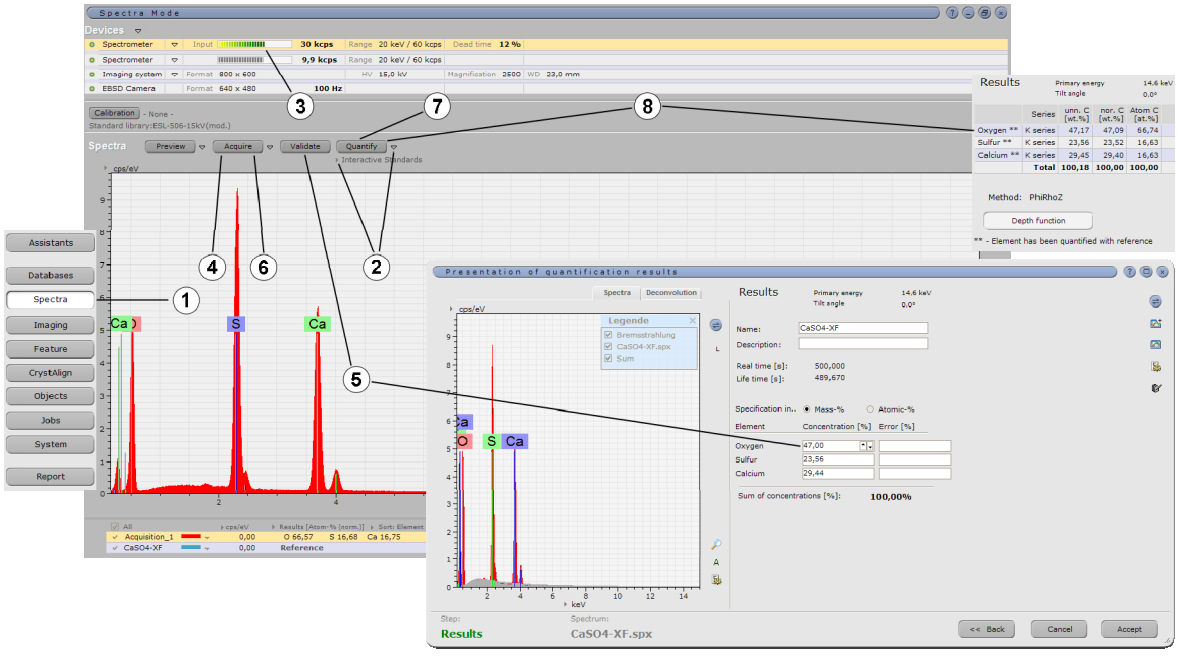

Fig. 4.4-1 Analysis with direct reference

4.5 Standard-based Analysis with Library

	Step	Example/hints
1	Select workspace **Databases** and click **EDS** if you want to change the assigned standard library, otherwise continue with step 3	*The assigned standard library is displayed next to the* **Calibration** *button in the* **Spectra** *and all* **Objects** *workspaces.* *If no EBSD system is installed, the* **EDS** *button will be activated by default.*
2	Select Standard Library	*Use the Import/Export menu from this workspace to open the desired library.*
3	Select workspace and standard-based method	*Refer to Fig. 4.5-2 form here onwards.* *Workspaces:* **Spectrum**, **Point**, *or* **Objects.** *Method e.g.:* **Interactive Standard.mtd**
4	Bring calibration sample into the analysis position and adjust microscope parameters	*The type of calibration sample is defined by the library and displayed in the dropdown list (top left in figure), for alternative samples refer to the according manual.*
5	Click the **Calibration** button	
6	Click **Acquire** to calibrate the system factor	*Do not change microscope parameters afterwards, repeat calibration regularly*
7	Bring the unknown specimen into the analysis position and click **Acquire**	
8	Click **Quantify**	*…unless automatic quantification after acquisition is enabled.*
9	Check results	*The result display will list which elements were quantified based on library standards*

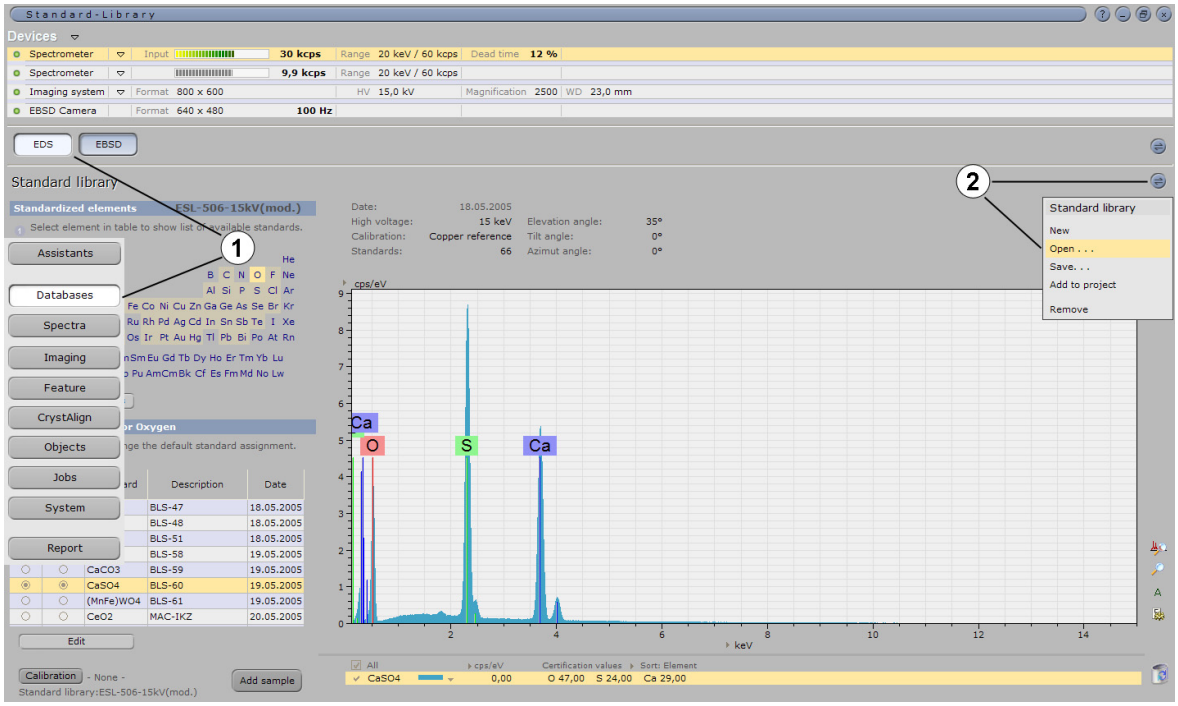

Fig. 4.5-1 Selecting the library for standard-based quantification

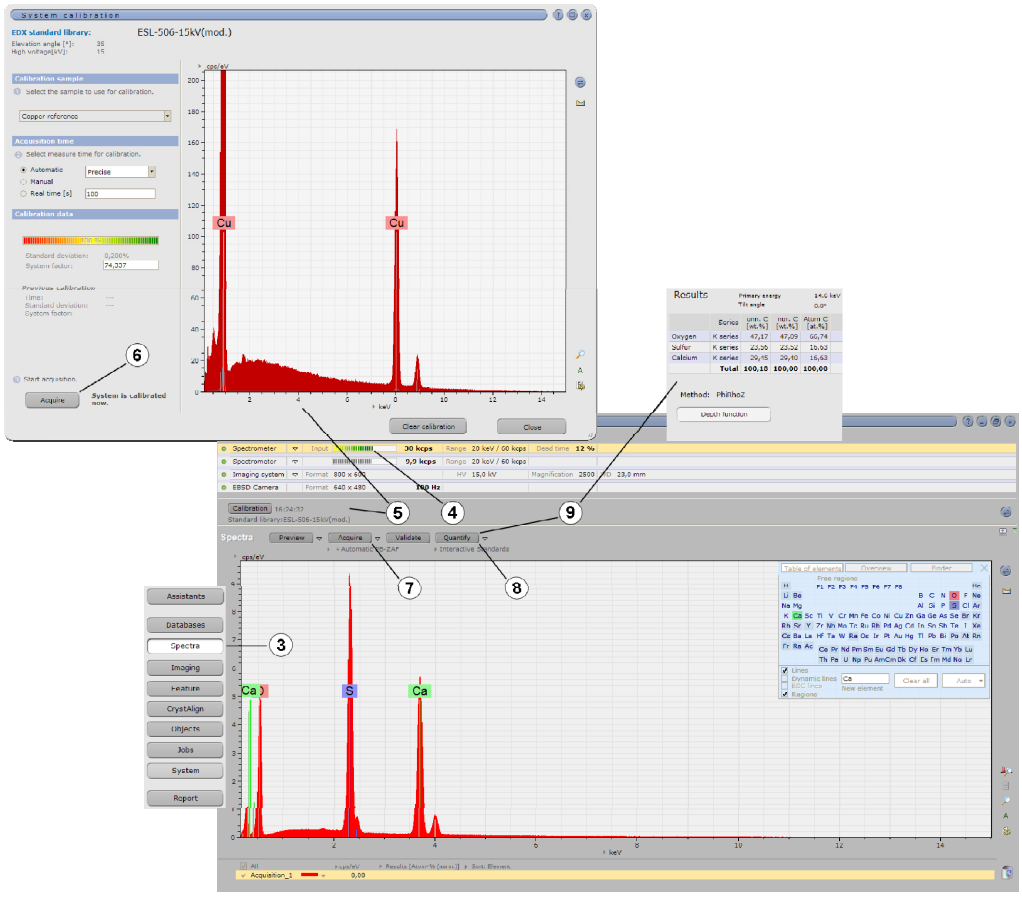

Fig. 4.5-2 Performing the actual quantification

4.6 Maintaining Standard Libraries

	Step	Example/hints
1	Select the **Databases** workspace and then **EDS**	*If you use a QUANTAX without EBSD system installed, EDS will be selected by default.*
2	Create a **New** library or **Open** an existing library for extension	*Use the workspace Import/Export menu (icon)*
3	Click the **Calibration** button	
4	Bring calibration sample into the analysis position and adjust microscope parameters	*The calibration sample is defined during creation of the library (function* **New***)*
5	Click **Acquire** to calibrate system factor	*Do not change microscope parameters afterwards, repeat calibration regularly*
6	Click the **Add sample** button	
7	Bring the standard sample into the analysis position and click **Acquire**	
8	Click **Validate** and enter the known element concentrations for the standards	*Confirm the assignment for all chemical elements to be referenced to that standard*
9	Repeat steps 7 and 8 until all samples are processed	*Check or edit the final element to standard assignments using the lower left-hand table in the* **Databases** *workspace*

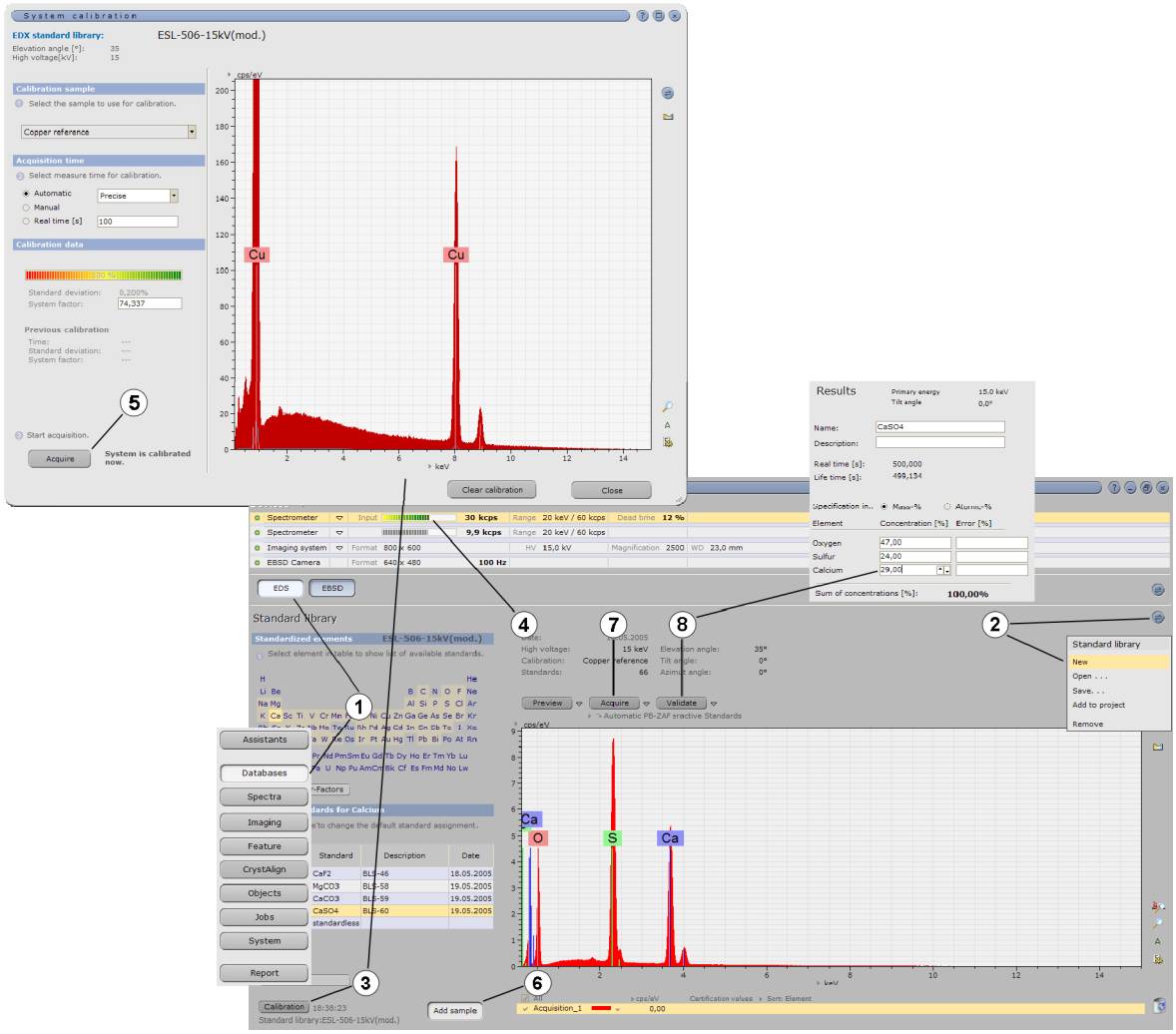

Fig. 4.6-1 Creating and maintaining standard libraries

4.7 Object Analysis

	Step	Example/hints
1	Prepare sample and select the **MultiPoint** workspace	*Adjust beam current if necessary in Point mode (preview)*
2	Click **New** to capture an image	
3	Position or draw any desired number of points, rectangles, ellipses or polygons	
4	Use **Select all** to highlight all objects	
5	Check if automatic analysis after acquisition is selected	
6	Click **Acquire** to start spectrum analysis	*Objects are automatically analyzed in sequence, the exact procedure depends on the analysis mode settings*
7	Check results	*Use Quick info behind the spectrum name in the spectra list or double-click according spectra display line for detailed results*

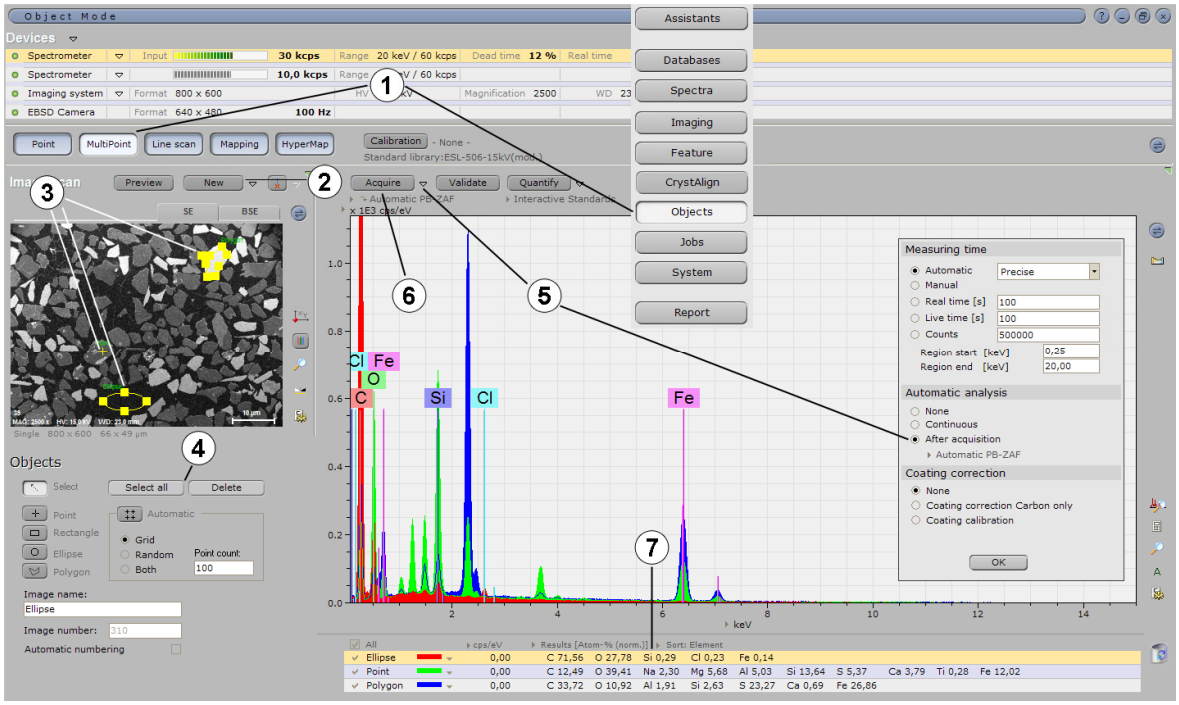

Fig. 4.7-1 Object analysis

4.8 Fast Line Scan

	Step	Example/hints
1	Prepare sample and select workspace **Line scan**	
2	Click **New** to capture image	
3	Adjust the scan line if desired	*Check the number of data points*
4	Select elements of interest using the interactive identification tool	*The element selection can be changed at any time during or after the line scan.* *If the sample is of unknown composition perform step 5 first and then identify the elements by using the identification tool on the sum spectrum (accessible through the* **Spectrum** *tab). Repeat step 5 if necessary to improve line scan quality.*
5	Click **Acquire** to start line scan	*Terminate the measurement when the concentration profiles are of sufficient quality or select an appropriate timing option*
6	**Save** results	

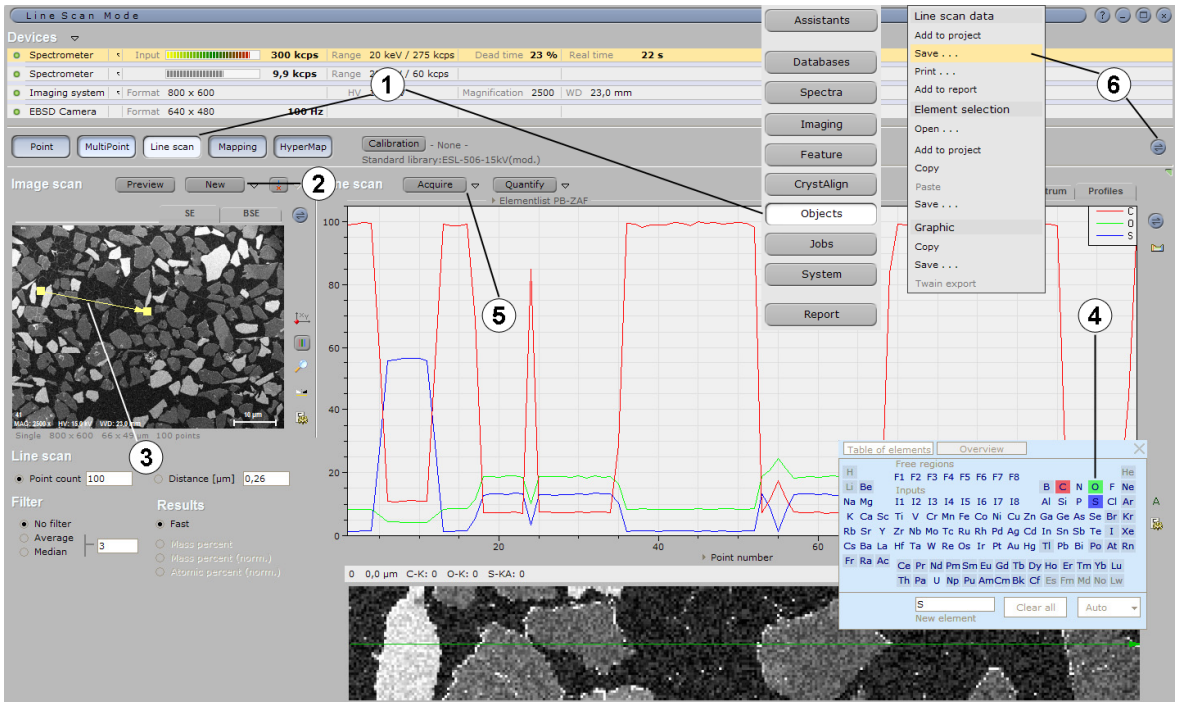

Fig. 4.8-1 Fast line scan

4.9 Fully Quantitative Line Scan

	Step	Example/hints
1	Prepare sample and select workspace **Line scan**	*Use relatively high electron beam current for line scan (green to red range)*
2	Click **New** to capture image	
3	Adjust the scan line if desired	*Check the number of data points*
4	Click **Acquire** to start line scan	*Terminate the measurement when the concentration profiles are stable or select an appropriate timing option*
5	Check analysis method	*Use* **Automatic PB-ZAF.mtd**. *If elements are known use* **Preset list**, *or if element markers are already set use identification option* **Line markers** *in the method editor (this is equivalent to using* **Element list PB-ZAF***)* (Ref. 4.1)
6	Click **Quantify** to analyze the line scan database	*Do not terminate measurement yet. Repeat quantification until statistics are sufficient*
7	Select the desired form of result presentation	
8	**Save** results	

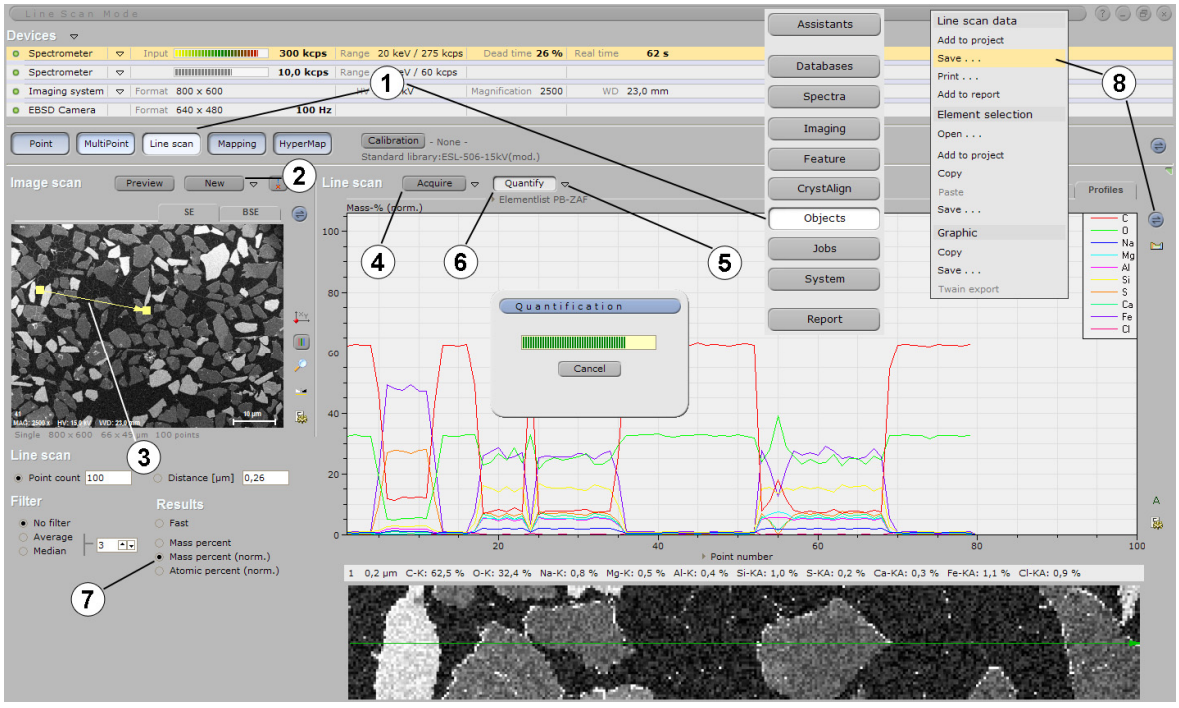

Fig. 4.9-1 Fully quantitative line scan

4.10 Fast Mapping

	Step	Example/hints
1	Prepare sample and select workspace **Mapping**	*For mapping use maximum electron beam current the sample can cope with*
2	Adjust image resolution	*Click on the bar* **Imaging system** *to introduce a new value*
3	Click **New** to capture image	
4	Adjust the map area if desired	*First map a small part of the image to check the performance. Note: The higher the resolution, the higher the map acquisition time*
5	Select elements of interest using the interactive identification tool	*Mapping element selection has to be carried out before starting the acquisition, e.g. by identifying the peaks in the sum spectrum of a single pass*
6	Click **Acquire** to start mapping	*Terminate acquisition when image quality is sufficient*
7	Adjust colors and image controls	*Image mixing can be changed at any time* *Try different image mixing modes for optimum results*
8	Save data with **Add to Project** and element image with **Save...**	*Do not forget to save the project itself from time to time*

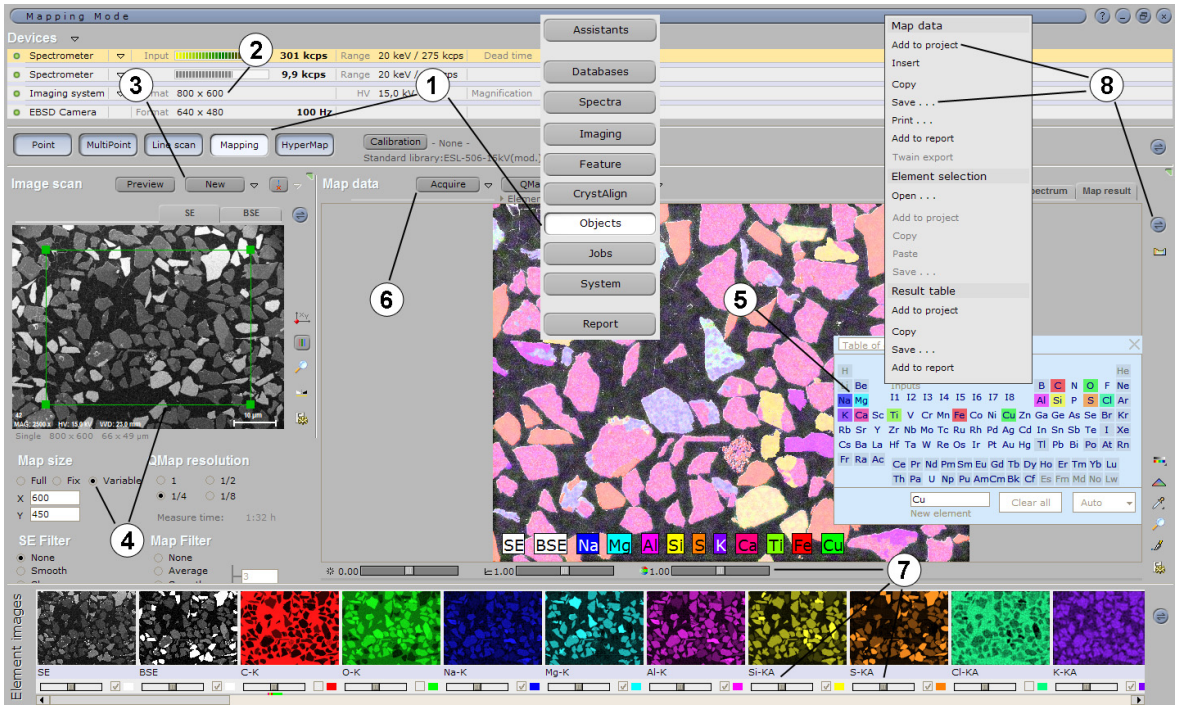

Fig. 4.10-1 Fast mapping

4.11 Fully Quantitative Mapping

	Step	Example/hints
1	Prepare sample and select workspace **Mapping**	*Use relatively high electron beam current for fully quantitative mapping (green to red range)*
2	Click **New** to capture image	
3	Adjust the map area	*QMap is time consuming. Use a low image resolution and as small a map area as possible*
4	Select map resolution	*Normally 1/4 or 1/8 of the image resolution is sufficient. Use the estimated* **Measurement Time:** *as an indicator*
5	Check analysis method	*Use* **Automatic PB-ZAF.mtd** *or* **Element list PB-ZAF.mtd** *and select elements before mapping. Adding elements later is impossible*
6	Click **QMap** to start mapping	*Mapping will terminate automatically after the last point has been quantified*
7	Adjust colors and image controls	*Image mixing settings can be made at any time.* *Try different image mixing modes for optimum results*
8	Save data with **Add to Project** and element image with **Save...**	

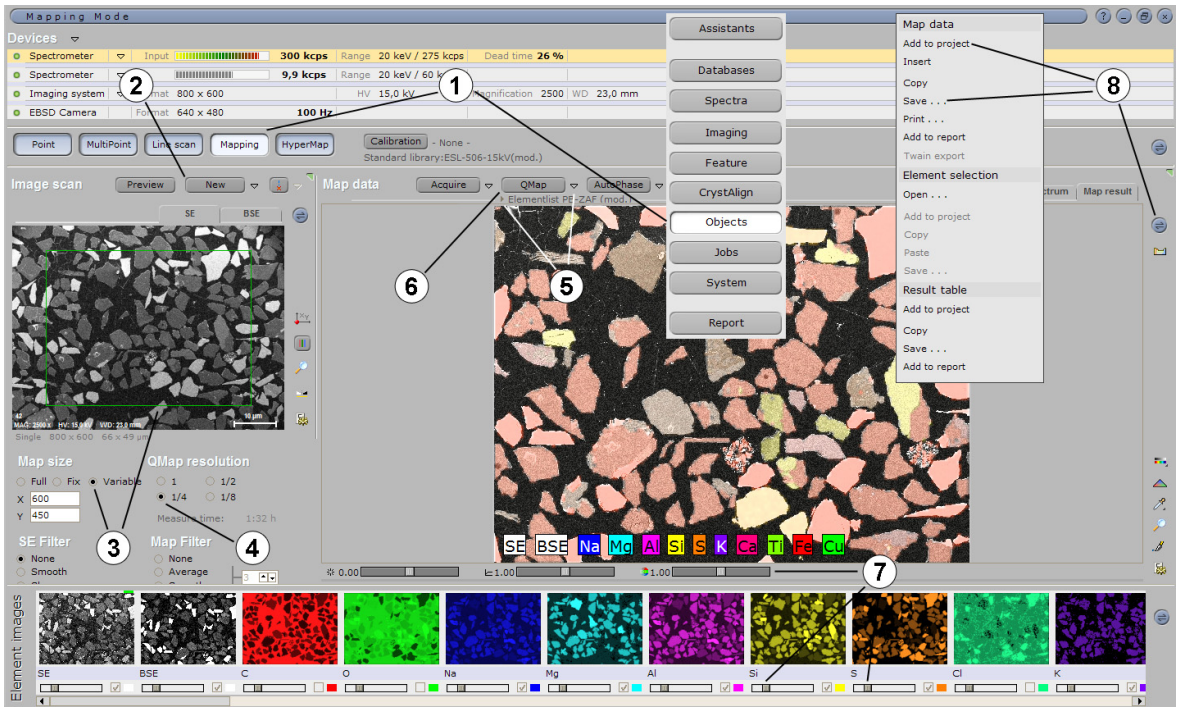

Fig. 4.11-1 Fully quantitative mapping

4.12 HyperMap

	Step	Example/hints
1	Select workspace **HyperMap**	*Use relatively high electron beam for good statistics*
2	Click **New** to acquire an image	
3	Select area to be mapped and determine image resolution	*Important: Use map resolutions of 1024 x 768 and below (640 x 480 is sufficient in most cases). Larger data files will prove difficult to handle.*
4	Set up acquisition	*Preferably use manual start / stop or cyclic acquisition (total duration depends on pixel dwell time set for the* **Imaging system***)*
5	Select elements to monitor mapping progress	*In contrast to classical mapping you can select and deselect elements any time, also during acquisition.*
6	Click **Acquire** to accumulate HyperMap	*Manual start /stop: For reasonably reliable quantification don't terminate acquisition before pixel spectra contain at least 5000 counts*
7	**Save** HyperMap database	
8	Process HyperMap data as desired	*You can perform quantitative analyses, line scans, phase analyses, etc.*

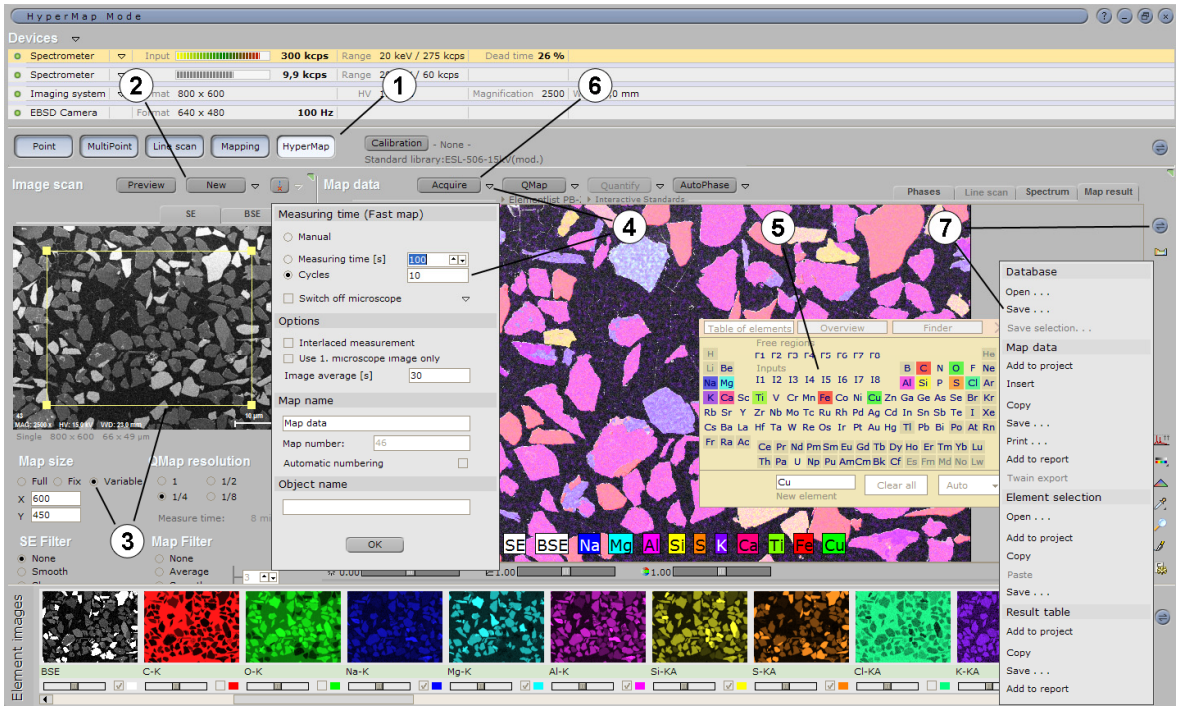

Fig. 4.12-1 Generating a HyperMap

4.13 Phase Analysis

	Step	Example/hints
1	Select workspaces **Mapping** or **HyperMap**	*Phase analyses can be performed on qualitative and quantitative maps as well as HyperMaps*
2	Select tab **Phases**	
3	Activate option **Automatic update**	*Optional step, useful when experimenting with methods and parameters as the phase image will update after every change*
4	Select method for phase determination	**Clusters** *or* **Objects** *normally provide best results.*
5	Adjust parameters	*Continue until desired results are attained. If this is difficult, a change of method is advised.*
6	Save results to project, an image file or report	*Use the Import/Export menu (icon). Remember to store the project from time to time as well.*

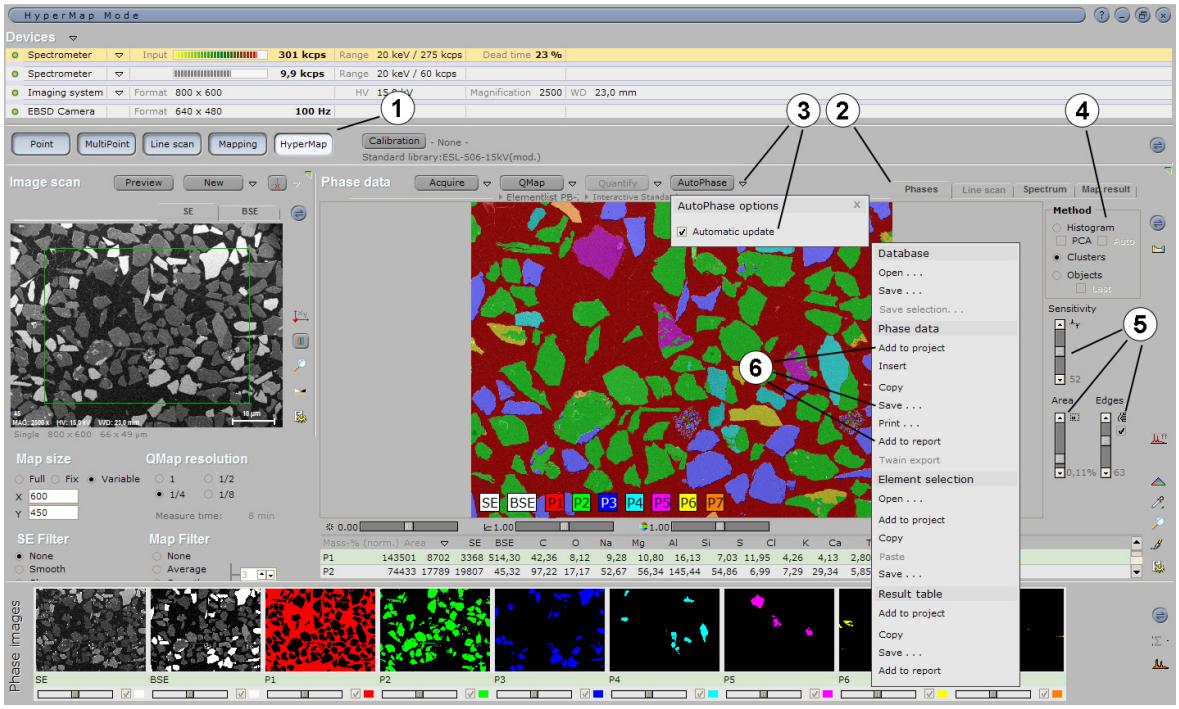

Fig. 4.13-1 Performing phase analyses

4.14 Image Processing

	Step	Example/hints
1	Prepare sample and select workspace **Imaging**	*Alternatively load a stored image into processing window and proceed with step 4*
2	Click **New** to capture image	
3	Drag image from capture window into processing window	
4	Select type of processing from the according tab	
5	Apply filter or perform other operation as appropriate	*E.g. start with sharpening or smoothing.* *The function of the slide controls vary with the chosen filter.* *If desired, drag intermediate images to the clipboard (visible as small images the bottom of the workspace)*
6	**Save** processed image or add it to the project or report	

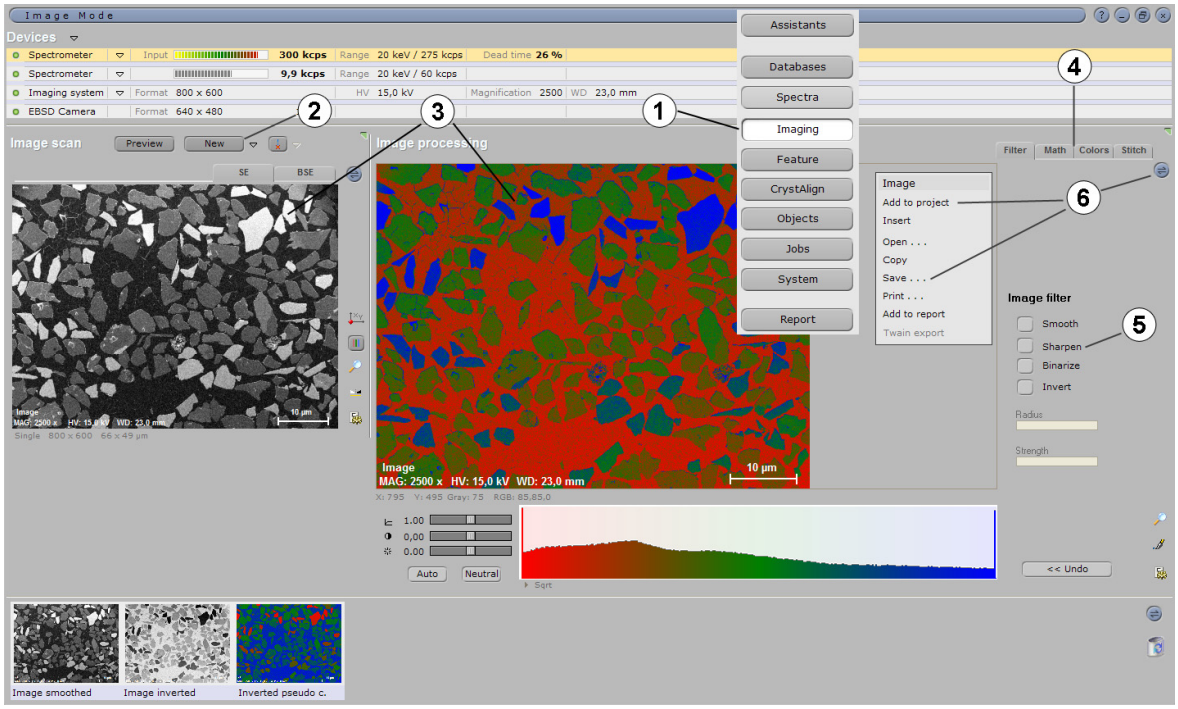

Fig. 4.14-1 Image processing

4.15 Using StageControl

	Step	Example/hints
1	Select appropriate workspace	*StageControl is accessible in workspaces that use image acquisition, all* **Objects** *workspaces,* **Imaging**, **Feature** *and* **EBSD**
2	Click **New** to acquire an image at the current stage position	
3	Click StageControl button to open the position list box	
4	Enter a name for the current position and click **+** to add it to the list	
5	Move the stage to the next position and repeat steps 2 … 4	*Continue until all analysis locations are in the list.*
6	Click StageControl button to open the position list box	*Continue with figure 4.15-2 from here.*
7	Select a position in the list by clicking on it	*You can use the thumbnail images that are displayed as an aid to identify the right position.*
8	Click **Go** to move the stage to the desired position	
9	Click **New** to acquire an image	
10	Select object(s) for analysis	*Points, objects, lines, maps, etc. are possible.*
11	Perform measurements as desired	

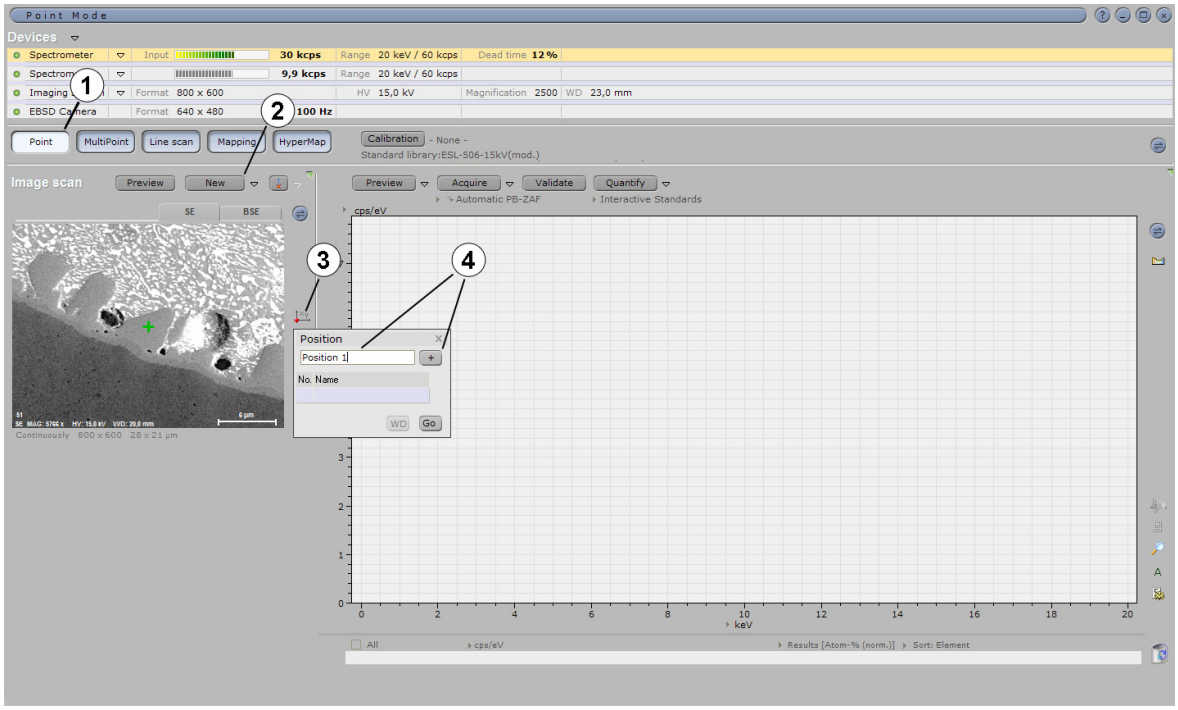

Fig. 4.15-1 Adding stage positions

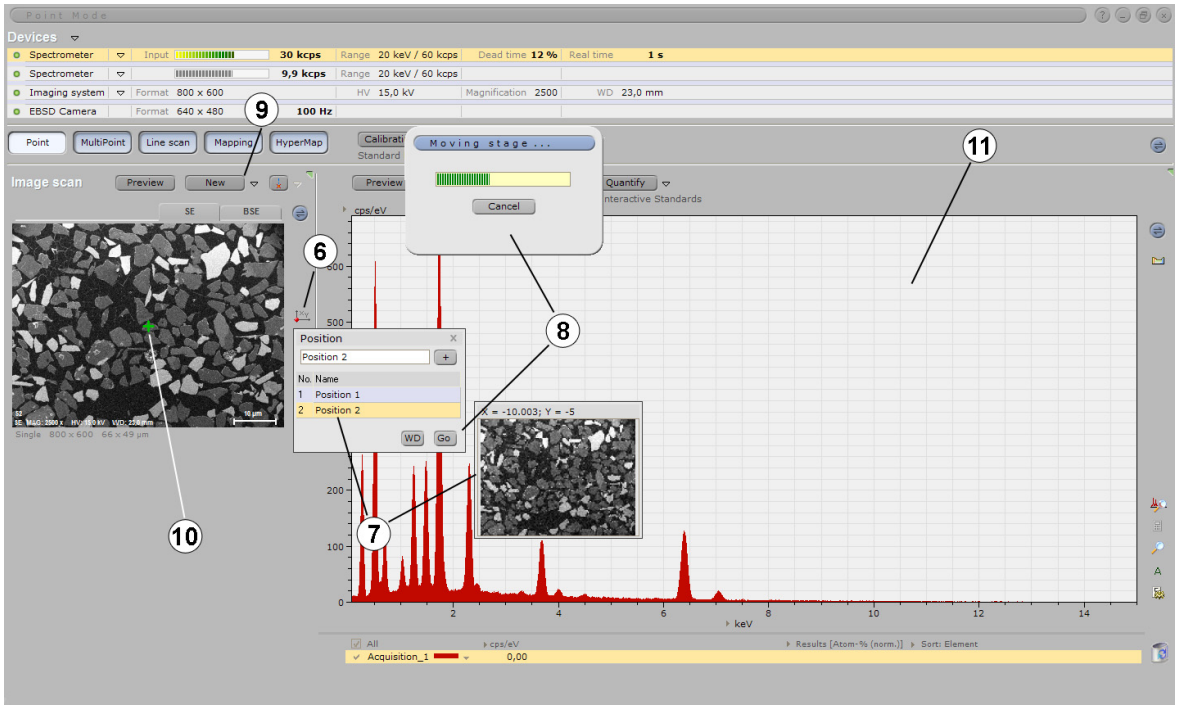

Fig. 4.15-2 Moving to a stage position

4.16 Analysis Automation Using Jobs

	Step	Example/hints
1	Move sample to the analysis position and select **Objects** workspace	
2	Click **New** to acquire an image at the current stage position	
3	Create objects for analysis	
4	Click **Select all** to highlight all objects	
5	Setup spectra acquisition and evaluation	*Be sure to select only automatic acquisition modes and evaluation methods!*
6	Add the job to the job list using the **Import/Export menu**	*Name the job and select parameters as shown.* *Reposition the stage and repeat steps 2, 3, 4 and 6 until all desired sample regions / samples are covered*
7	Select **Jobs** workspace	*Continue with Fig. 4.16-2 from here*
8	Add a name for the current job list, if desired	
9	Highlight job in list and click **Edit**	
10	Click on the arrow next to **Results handling**	
11	Check **Export to file** and choose a folder where to store the results by clicking on the arrow below	*You can also add the results to a report file by activating the* **Add to report** *checkbox. Afterwards choose a template by clicking on the arrow below.* *Repeat steps 9 to 11 until all jobs in the list are processed.*
12	Click **Start** to process job list and perform automated measurements	

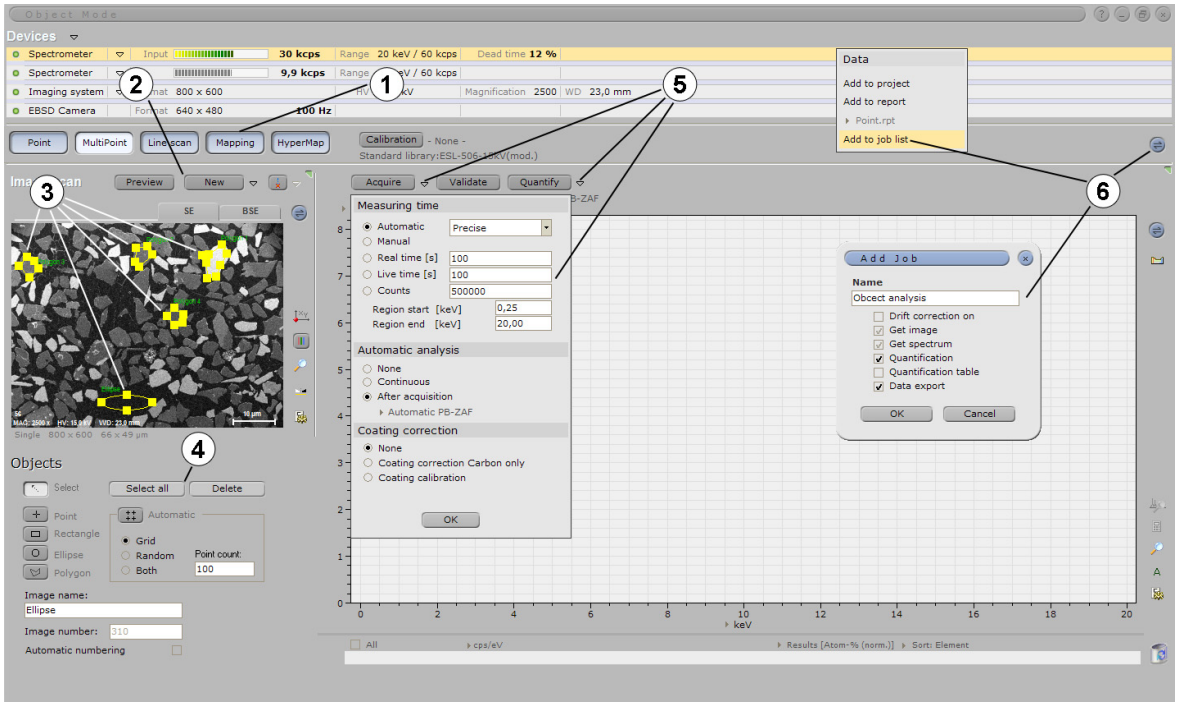

Fig. 4.16-1 Creating a job

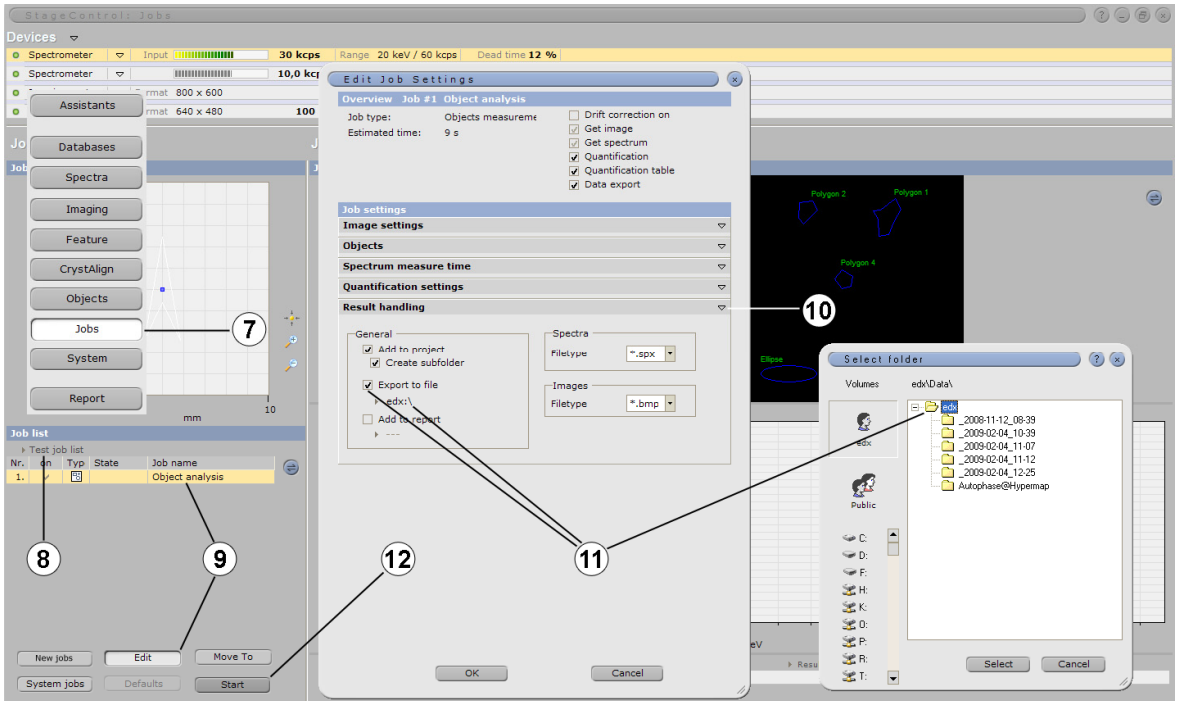

Fig. 4.16-2 Editing and running jobs and job lists

4.17 Stage Mapping using Jobs

	Step	Example/hints
1	Prepare the sample and select the **Mapping** workspace	
2	Click **New** to acquire an image	
3	Set the map area to **Full** image size	*If you want to map quantitatively do not forget to reduce the QMap size, otherwise your stage mapping may take excessively long.* *Note that you can also choose HyperMap, same applies here*
4	Set up acquisition time	*Choose automatic acquisition, either in* **Cycles** *or seconds* (**Measuring time**)
5	Select elements to be mapped using the identification tool	
6	Add the mapping setup to the job list	*Give this job a meaningful name*
7	Change to the **Jobs** workspace	*Refer to Fig. 4.17-2 from here onwards*
8	Highlight the job just created and click **New jobs**	*This ensures that this job will be used as a master to clone all mapping jobs from.* *Before doing so, you may also edit the master job's* **Results handling** *properties, if you wish to store all results directly to disk instead of just adding the to the current project.* *You may also assign a name to the job list. (Ref. 4.16)*
9	Enter a meaningful name for the mapping jobs to be generated	
10	Select **Rectangle** as scanning area and activate **Variable stage area**	
11	Define the **Grid** into which the scanning area is to be subdivided	*e.g. 10 steps horizontally and 10 steps vertically.* *Note that the number of grid points is identical to the number of maps to be performed. Time factor!*
12	Define horizontal and vertical **Overlap** of maps	
13	Click **OK**	*The system will now generate a mapping job for every grid point (stage position) and will clone all acquisition settings from the master job.*
14	Click **Start** to process the job list and perform the stage mapping	

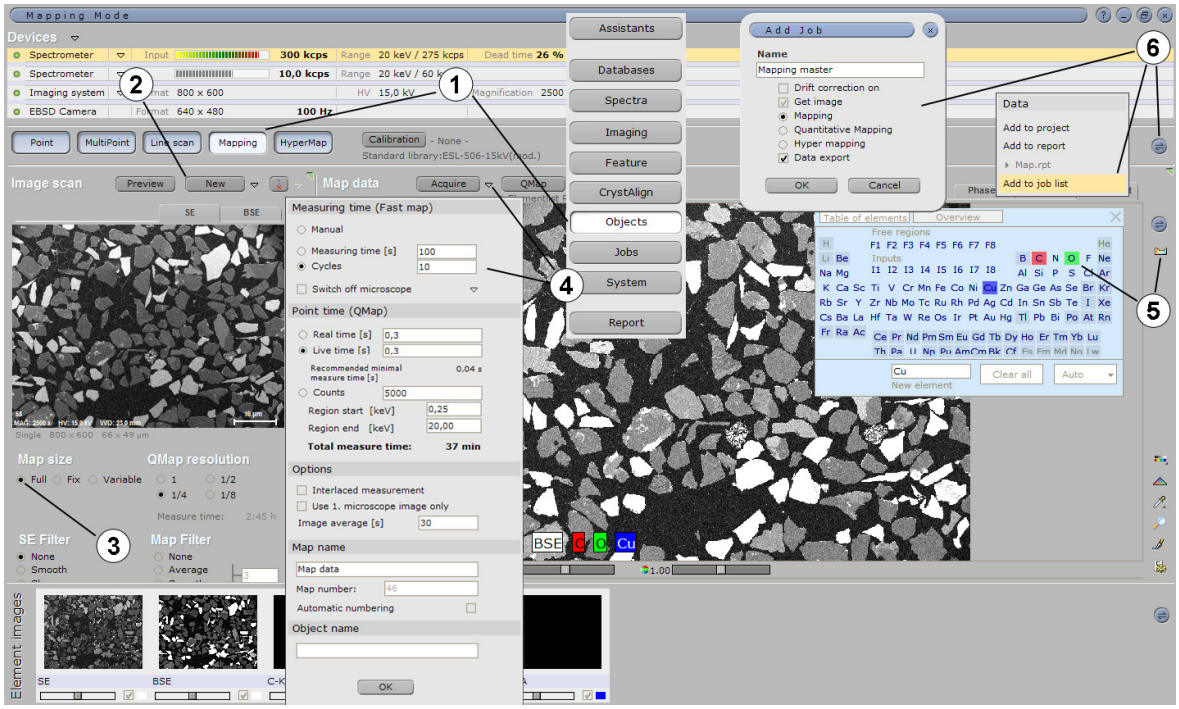

Fig. 4.17-1 Defining a mapping job as a master for stage mapping

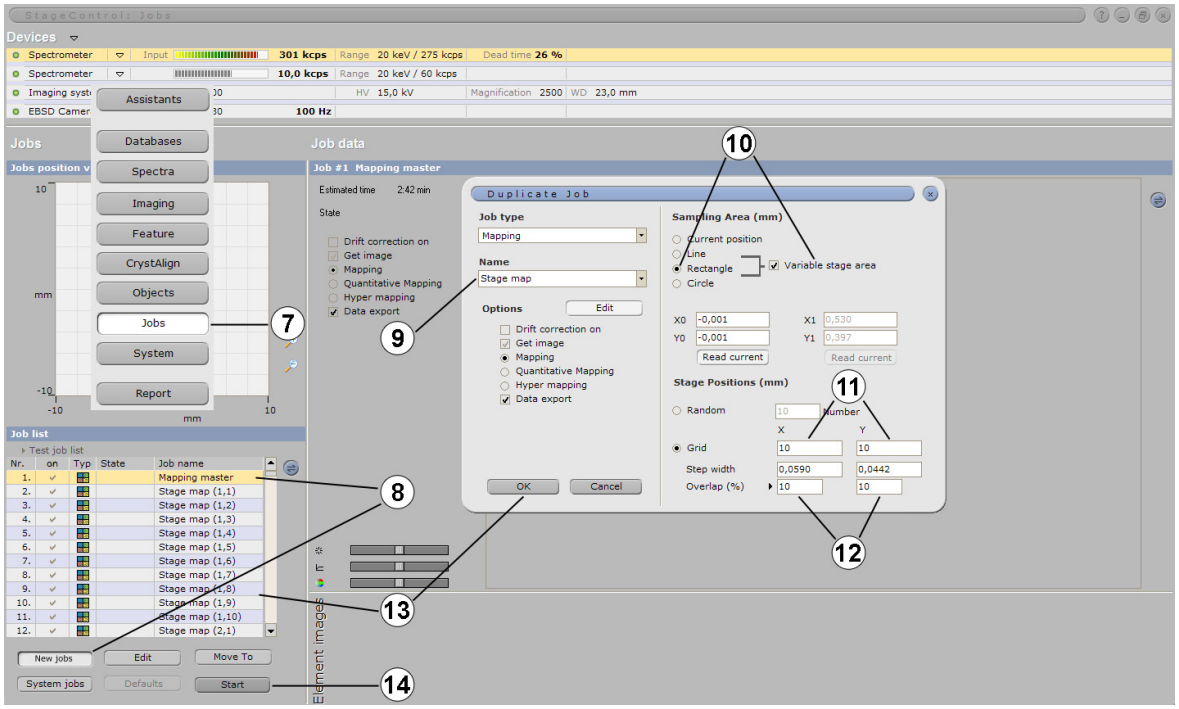

Fig. 4.17-2 Setting up and running the stage maps

4.18 Creating a Report

	Step	Example/hints
1	Perform an analysis in a workspace of the **Objects** group	*Reports can also be composed from files or project entries*
2	Select **Add to Report** from the group level Import/Export menu	*This will add all results to the report (mapping, sum spectrum image and element miniatures)*
3	Open the Report editor	
4	Add texts or legends, draw objects, or rearrange items as desired	
5	Save your work using the Report Import/Export menu	*Reports can also be sent to Microsoft Word for further processing/archiving.*
6	**Print** the report	*Check page* **Setup** *before printing*

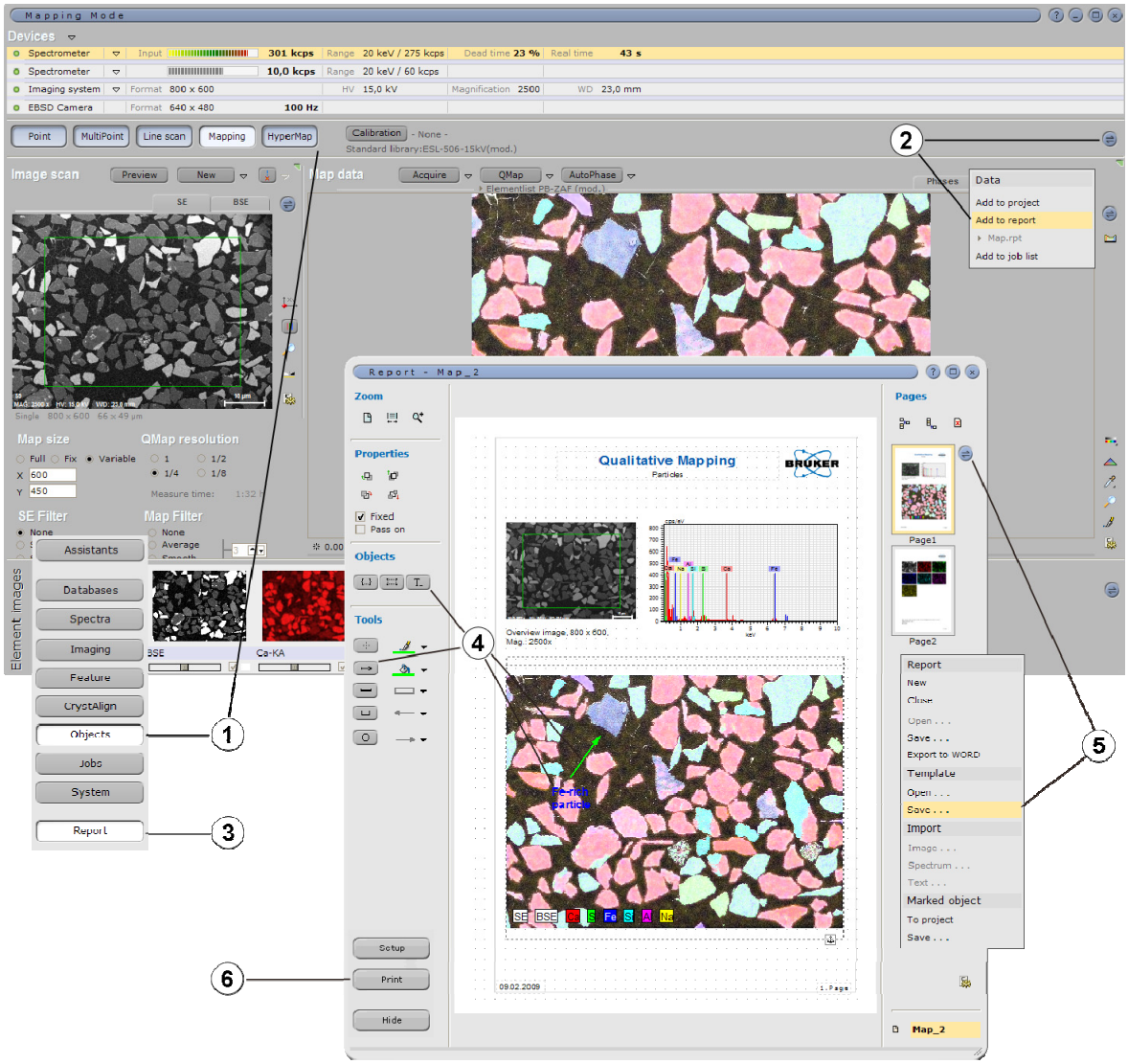

Fig. 4.18-1 Creating a report

5 Buttons, Icons, Controls Quick Guide

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5.1 Startup Screen and Main Program Window

5.1.1 Startup Screen

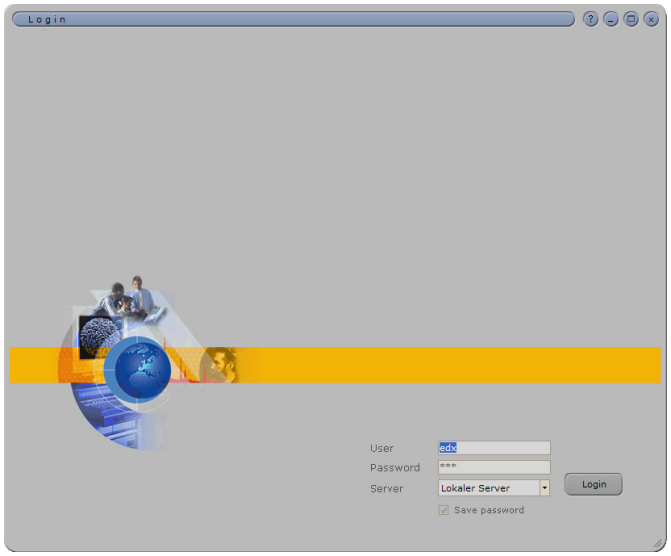


Fig. 5.1-1 ESPRIT Startup screen

Object	Description	Hints
User	User name	
Password	Password	
Server	Server selection dropdown list	
Save password	Remember password on this computer	
Login	Login current user	

5.1.2 Main Program Window and General Controls

Includes the **Devices** *and the* **Project** *screen section.*

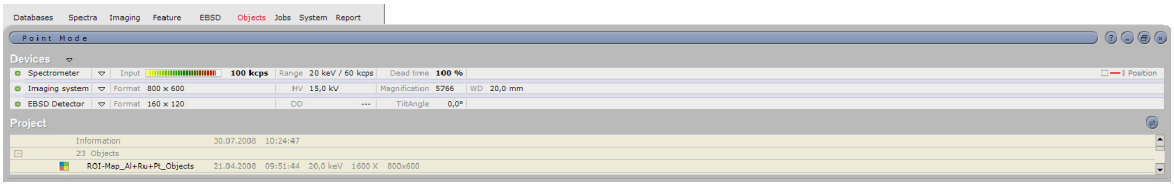
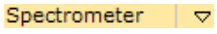
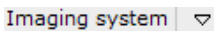
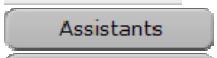
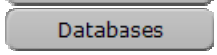
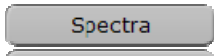
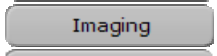
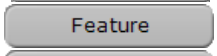
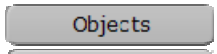
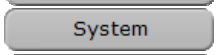
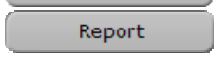
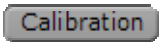


Fig. 5.1-2 Top section of ESPRIT program window with main menu in fullscreen mode

Object	Description	Hints
	Invoke online help system	*Context sensitive in the workspaces / dialogs*
	Minimize program	
	Fullscreen mode on	
	Fullscreen mode off	
	Close program	*Closes window and shuts down program*
	Import/Export menu icon	*Available I/O functions depend on workspace*
	Load / save device presets	*Manages imaging system and spectrometer settings optimized for different analytical tasks*
	Configure spectrometer	
	Configure imaging system	
	Drive detector in and out	
	Workspace Assistants	
	Workspace group Databases	**Databases** / **EDS** *is identical to main menu item* **Standards** *in pre 1.9 releases of ESPRIT*
	Workspace Spectra	
	Workspace Imaging	
	Workspace Feature	*Refer to ESPRIT Feature manual*
	Workspace EBSD	*Refer to QUANTAX CrystAlign manual*
	Workspace group Objects	
	Workspace Jobs	
	Workspace group System	
	Report editor	

5.2 Workspace Buttons and Controls

This section summarizes all controls for the workspaces. Note that some of the controls and buttons are common to several or all workspaces, these are dealt with directly below.

Object	Description	Hints
	Maximize window to fullscreen	
	Minimize window to normal size	
	System factor calibration	*Required for reliable quantitative PhiRhoZ-analysis. Right of the button is the time of the last calibration, below the name of the current standard library. Do not mix up with energy calibration*
	Delete highlighted object	*Does not affect saved items*
	Zoom image to original size	

5.2.1 Workspace Assistants

The main menu changes to fullscreen mode when entering the workspace Assistants.

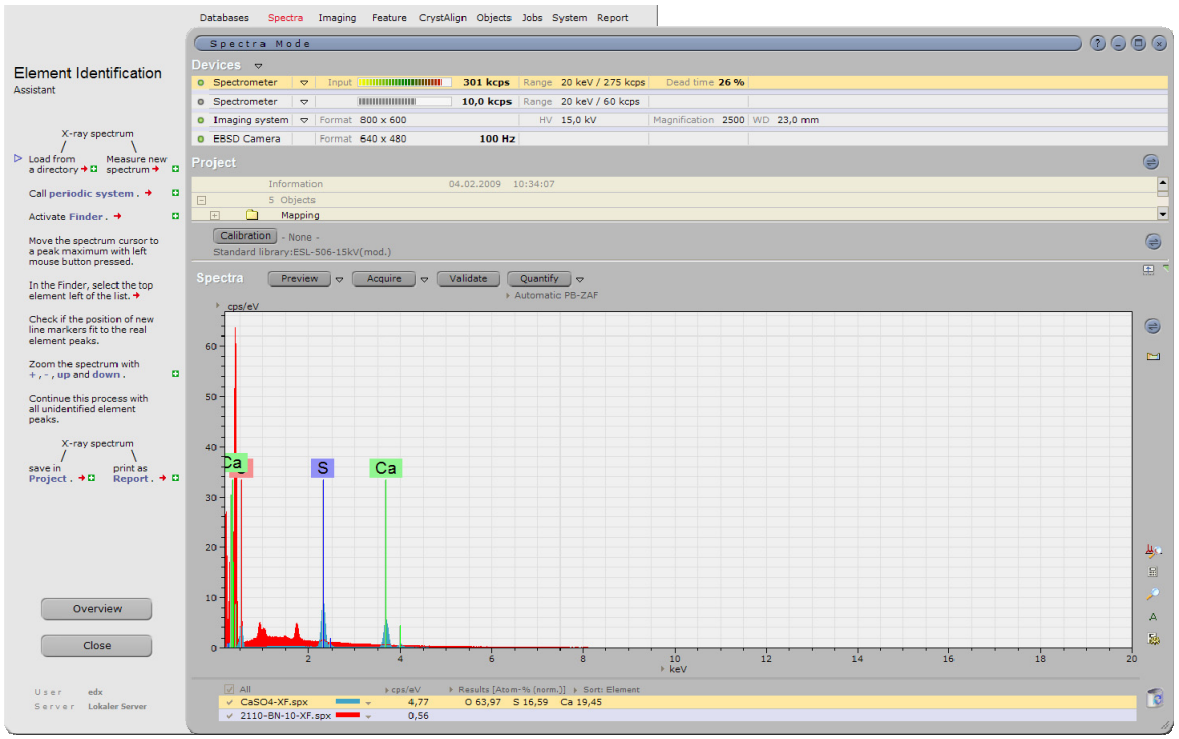


Fig. 5.2-1 The Assistants workspace replacing the standard main menu

Object	Description	Hints
	Perform step (go to…)	
	Provide additional help /info text	
	Position indicator	*Marks the step currently selected for performance*
Overview	List all assistants	
Close	Close Assistant workspace	*Displays "normal" main menu*

5.2.2 Workspace Databases EDS

For description of Databases / EBSD please refer to the QUANTAX CrystAlign manual. The description of the spectra window can be found in section 5.2.3 below.

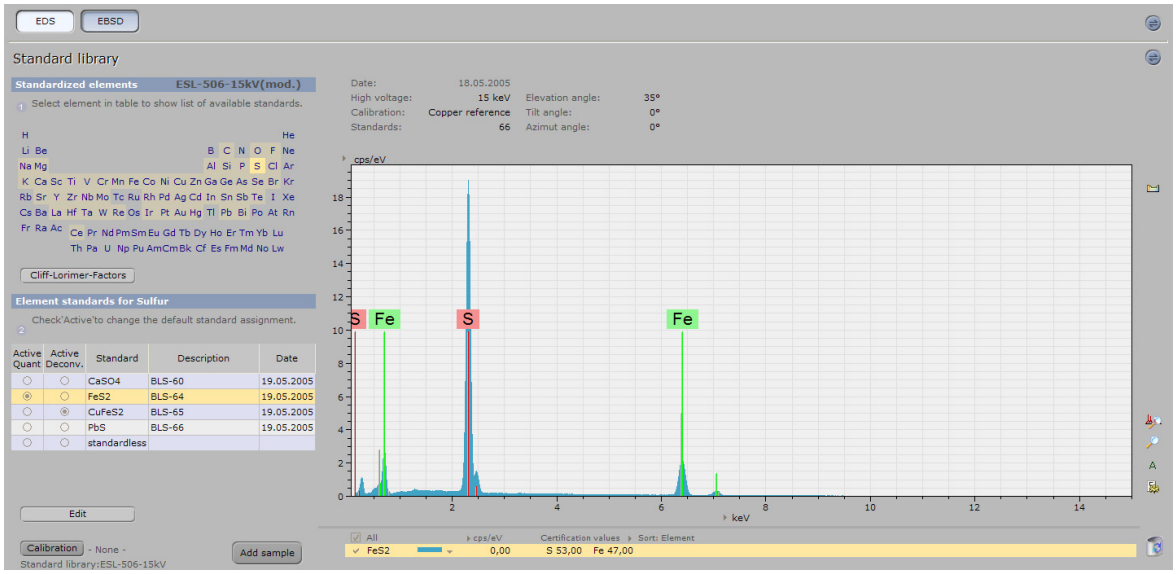


Fig. 5.2-2 The workspace Databases / EDS with spectra window displayed

Object	Description	Hints
S	Selected element	*Clickable periodic table display for standard processing. All elements for which a standard is available have a light yellow background*
Cliff-Lorimer-Factors	Edit Cliff-Lorimer factors	*Required for quantitative TEM-analysis*
Active Quant	Radio buttons, select standard for quantification	
Active Deconv.	Radio buttons, select standard for peak deconvolution	
Edit	Edit Standard properties	
Add sample	Add sample to standards database	

5.2.3 Workspace Spectra

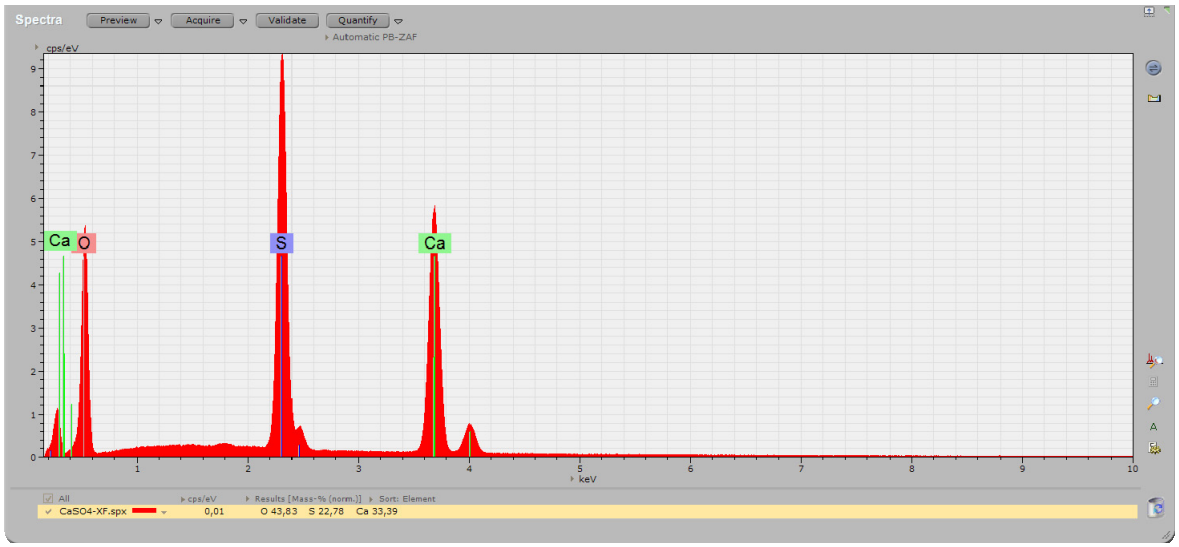


Fig. 5.2-3 Spectra workspace with spectra display

Object	Description	Hints
Preview	Activate high speed spectra preview	
Preview	Configure spectra preview	
Acquire	Acquire spectrum	
Acquire	Configure acquisition settings	
Validate	Validate spectrum	*Used for reference based quantification. Enter known element concentrations here.*
Quantify	Quantify spectrum	*Use method displayed below the button*
Quantify	Load quantification method from disk	
Automatic PB-ZAF	Edit current method	*Opens the so-called method editor for modification of the current quantification method*
	Maximize spectra window	*Toggles between normal and maximized spectrum window display (covers project and devices areas)*
cps/eV	Change Y axis units	*Toggles between* **cps/eV** *and* **pulses/eV**. *Also applies to the similar control above the spectra list*
	Open interactive element identification tool	*Clickable periodic table of elements and peak finder (at current cursor position)*
	Search volumes for similar spectra	
	Spectrum arithmetic	*Add, subtract, multiply spectra*
	Auto scale spectra window according to foreground spectrum	

	Edit spectrum display settings	
keV	Change X axis units	*Toggle between energy in* **keV** *and* **channel** *display. Double-click on* **keV** *or* **channel** *to introduce an energy range.*
All	Select all spectra for display	
CaSO4-XF.spx	Select spectrum for display	*Highlighted spectra (yellow line in spectra list) will always be displayed, whether selected or not*
Results [Mass-% (norm.)]	Units for results display	
Sort: Element	Sort order	*Either ascending according to atomic number (***Element***) or descending depending concentration (***Value***)*

Hot keys	**Description**
Alt + click and hold + move right or left	Move a spectrum to the right or to the left
Ctrl + click and hold + move right or left	Broaden or narrow a spectrum
Shift	Select several spectra from the list
Del	Delete a spectrum from the list

5.2.4 Workspace Imaging

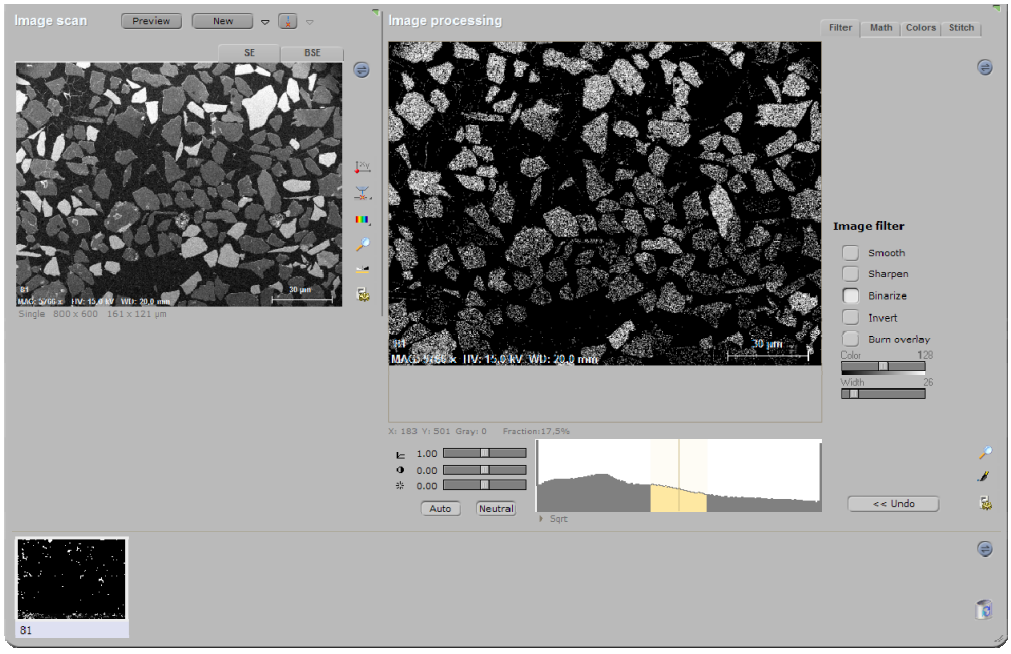
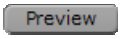
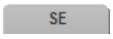
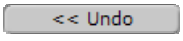


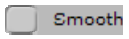
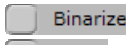
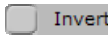
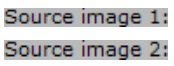
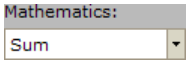
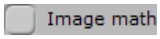
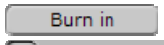
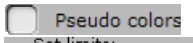
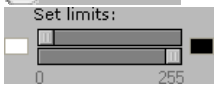
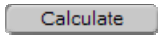
Fig. 5.2-4 The workspace Imaging with image scan and image processing windows

5.2.4.1 Image Scan Window

Object	Description	Hints
	Preview image	*Opens a live scan window to check image detail and scan settings*
	Acquire image	
	Set image acquisition mode	*Single, averaging or continuous*
	Activate image drift correction	
	Configure image drift correction	*Can only be done when drift correction is active*
	Image channel 1	*Normally SE*
	Image channel 2	*Normally BSE*
	Access StageControl menu	
	Activate ColorScan	*Overlays electron image with an image color coded according to elements present. Requires XFlash® Detector at high beam currents for proper function*
	Select parking position for electron beam	
	Image settings	*Set brightness, contrast, gamma correction and scan speed for image acquisition*
	Set image options	*Configure legend, add name or comment*
	Info on scanned image	*Displays image size in pixels and scanned area in µm² and how many times the image was overlaid*

5.2.4.2 Image Processing Window

Object	Description	Hints
	Processing window info	*Displays different parameters according to context, e.g. mouse cursor position over image in pixels, grey level or color at cursor position, fraction original image contained in binary image*
	Gamma correction control	
	Contrast correction control	
	Brightness correction control	
	Auto contrast and brightness	
	Set gamma correction, contrast and brightness	*Returns all controls to center position*
	Change scaling of histogram y-axis	*Choose between **Lin**ear, **Log**arithmic and **Sq**uare **ro**ot. Useful for enhancing details*
	Undo up to 5 operations	
	Open dialog with drawing tools	*Overlay image with text, points, lines, arrows, rectangles and ellipses. Can be edited and*

		removed.
	Set image options	*Set legend, name or comment*
	Tab to access image filters	
	Smooth image	
	Sharpen image	
	Binarize image	
	Invert image	
	Radius of filter matrix in pixels	*For smoothing and sharpening filters*
	Strength of filtering operation in percent	*For smoothing and sharpening filters*
	Center color (or grey level) of region for binarization	
	Width of region for binarization in colors / grey levels	
	Tab to access image arithmetic	
	Source images for performing mathematic operations	*Drag and drop from image scan or image processing window, directly from image clipboard will not work. Both sources must have same color depth, math using one grey and one color image will not work*
	Dropdown list of available operations	
	Set contribution of source image 1 and 2	*Selectable between 0 and 1, 0.5 each means equal contribution from both source images*
	Perform selected operation	*Result will be presented in the processing window*
	Tab to access artificial image coloring	
	Add color scale used to image	
	Convert to pseudo colors	*According to selection below*
	Set black and white limits to color conversion	*Black and white may be exchanged with other colors by a click on the according color symbol left and right of the controls*
	Convert according to RGB color scheme	*Different colors may be selected by clicking on the respective color symbols*
	Convert according to palette	
	Load palette for conversion from disk	
	Access image stitching function	*Optional!*
Columns:	Number of columns of image tiles to be used	
Rows:	Number of rows of image tiles to be used	
Overlap:	Define overlap source images were recorded with	
	Stitch tiles together	

Result image	Show resulting image in processing window	*Once clicked changes to* **Source images**, *to return to source image view*

5.2.5 Workspace Group Objects

5.2.5.1 Workspace Point

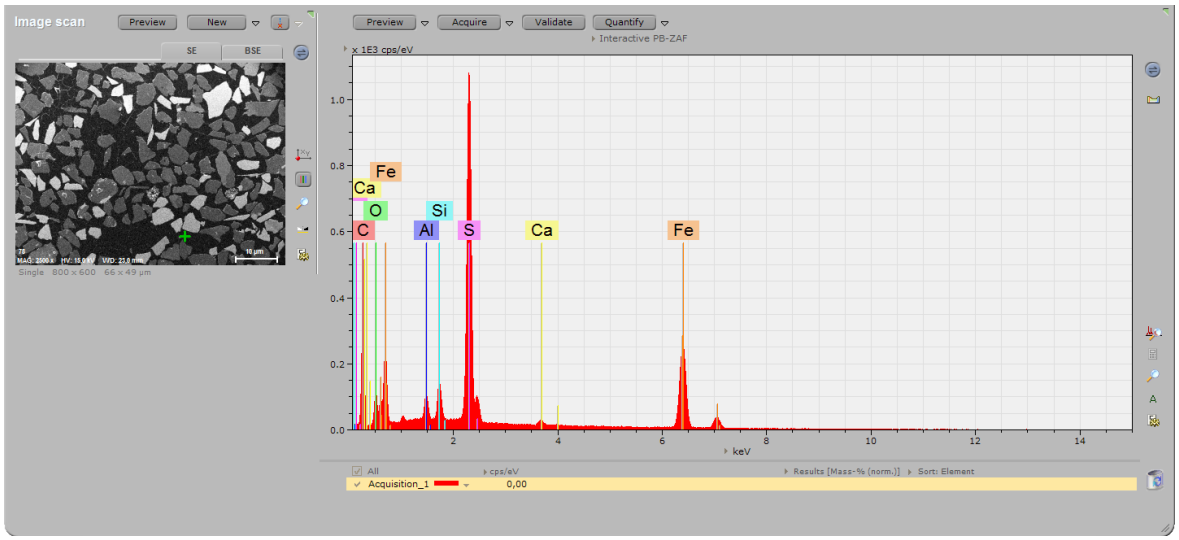


Fig. 5.2-5 The workspace Point with image scan and spectra windows

Click into the scan window to set the measurement point. For information on the image scan window refer to section 5.2.4.1. The spectra window is described in section 5.2.3.

5.2.5.2 Workspace Objects

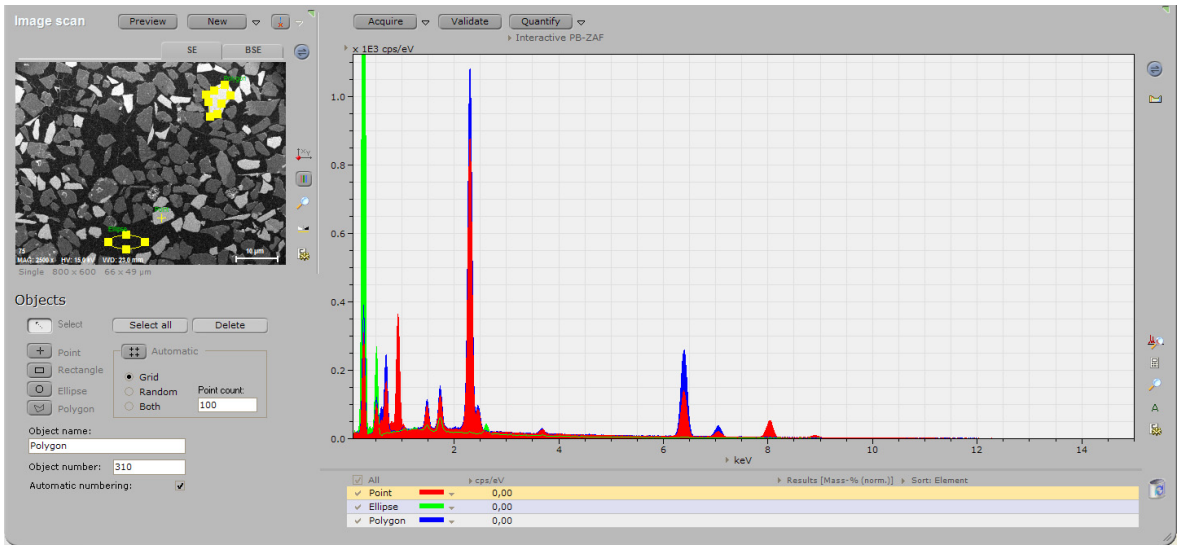


Fig. 5.2-6 The workspace Objects with image scan and spectra windows

In this section you will find a description of the objects below the image scan window. The image scan window itself is described in section 5.2.4.1, the spectra window in 5.2.3.

Object	Description	Hints
	Select mode	*Click button to be able to select objects already drawn*
	Draw points	
	Draw rectangles	
	Draw ellipses	
	Draw polygons	
Object name:	Object name	*Enter a name for the objects to be used in the image and for the spectra. If* **Automatic numbering** *is activated all objects will receive this name plus a consecutive number, beginning with the one entered under* **Object number**. *Otherwise a unique name has to be entered for every new object.*
Object number:	Object number	
Automatic numbering:	Automatic numbering on / off	
Select all	Select all objects	
Delete	Delete selected objects	
	Create measurement points automatically	*…according to the parameters below. Number of points created depends on entry in* **Point count** *field*
Grid	Create rectangular point grids	
Both	Align points roughly with grid lines	
Random	Position points randomly within field of view	
Point count:	Number of points to be created	

5.2.5.3 Workspace Line Scan

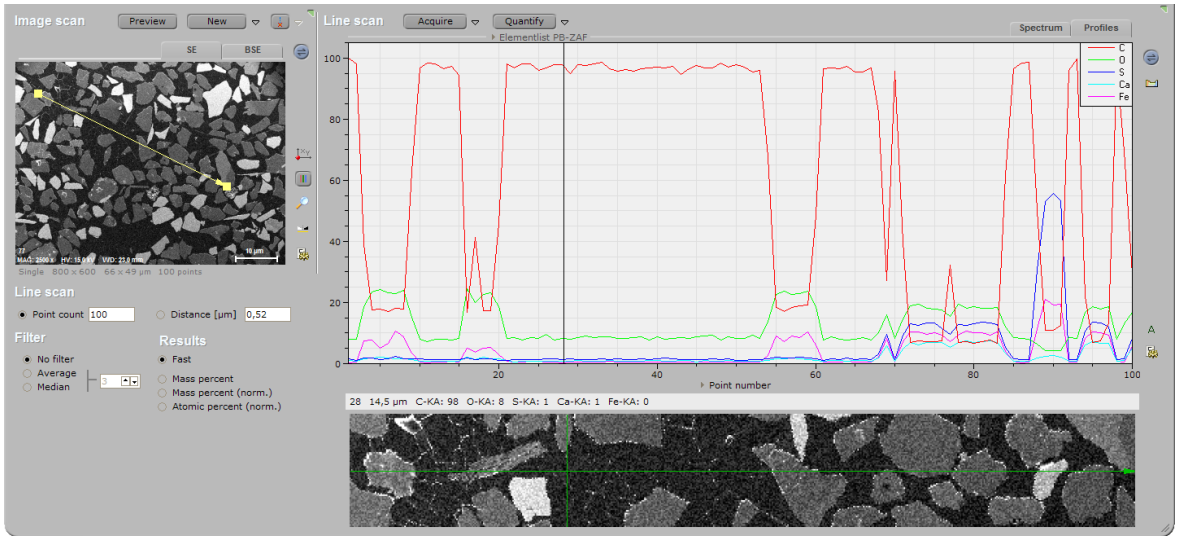


Fig. 5.2-7 The workspace Line scan with image scan and profile window

Use the mouse over the image scan window to drag both ends of the scan line to the desired positions. Information on the image scan and spectrum windows (under the Spectrum tab) can be found in sections 5.2.4.1 and 5.2.3, respectively.

Object	Description	Hints
Point count	Set number of points along the scan line	*Will alter the* **Distance [µm]** *between points*
Distance [µm]	Set distance between points along the scan line	*Will alter the number of points, as displayed under* **Point count**
No filter	Use no filter on lines	
Average	Average over adjacent points of the line scan	
Median	Use median filter on line scan	
3	Number of points to be considered for averaging or median filter	
Fast	Fast line scan (qualitative)	
Mass percent	Scale profile window Y-axis in mass percent	**Quantify** *has to be clicked beforehand for this option to work*
Mass percent (norm.)	Scale profile window Y-axis in mass percent, normalized	
Atomic percent (norm.)	Scale profile window Y-axis in atomic percent, normalized	
Acquire	Acquire line scan	
Acquire	Set acquisition parameters	
Quantify	Quantify line scan	
Quantify	Select quantification method	
Elementlist PB-ZAF	Edit selected quantification method	
Profiles	Tab to access profile window	
	Identification tool	*Use to select element profiles to be displayed*
	Autoscale profile window	
	Options for profile window	
Spectrum	Tab to access spectrum window	*For details see section 5.2.3*

5.2.5.4 Workspace Mapping

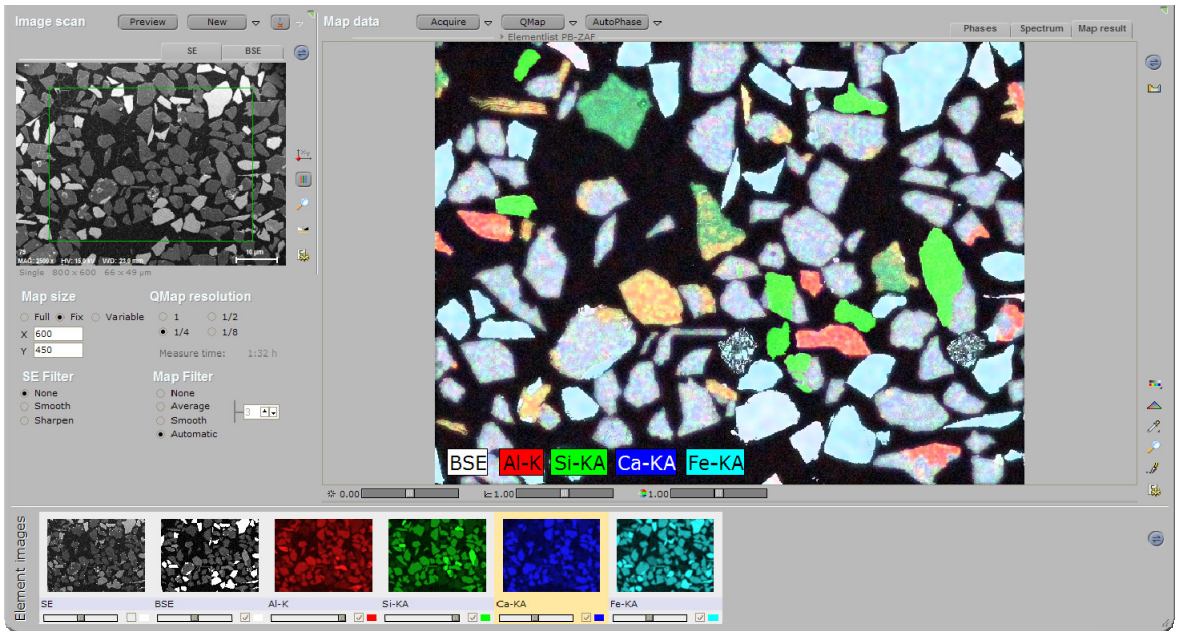
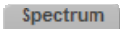
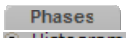
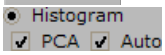
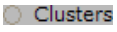
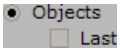
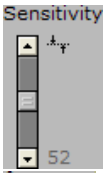
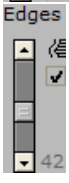


Fig. 5.2-8 The Mapping workspace with image scan and map window

Object	Description	Hints
Full	Full SE image size mapping	
Fix	Fixed size mapping	*Enter* **X** *and* **Y** *sizes in fields below*
Variable	Variable size mapping	*Use the mouse over the image scan window to drag the corners of the frame to the desired position*
X 600 Y 450	Entry field for fixed size maps	*Will also display the size of variable maps.*
None	Use no filter on SE image	
Smooth	Smooth SE image	
Sharpen	Sharpen SE image	
1 1/2 1/4 1/8	Set size of a quantitative map	*… as a fraction of the fast map size. QMaps are time consuming, 1/4 or even 1/8 size are sufficient*
None	Use no map filter	
Average	Averaging map filter	
Smooth	Smoothing map filter	
Automatic	Automatic map filter	
3	Set filter matrix size	
Acquire	Acquire fast map (qualitative)	
Acquire	Set acquisition parameters	
QMap	Acquire quantitative map	
QMap	Load quantification method	
Automatic PB-ZAF	Edit quantification method	
Map result	Access map results window	*Default*
	Element identification tool	*Use to select elements for mapping*

	False color palette	*Use as an alternative to standard mapping colors*
	Binary and ternary diagrams Draw objects for analysis	*Points, rectangles, ellipses and polygons, not to be mixed up with the drawing tool*
	Drawing tool Map options	
	Map brightness control	
	Map gamma control	
	Map color intensity control	
	Element contribution control / phase contribution control (**Phases** tab)	*Use to control color intensity of element / phase, to switch contribution to map or phase image on / off (check box), or change the associated color by clicking on the color field*
	Access spectrum window	*Refer to section 5.2.3*
	Access Phases window	
	Use histogram method, enable PCA and auto binning	*Works directly on the element intensities (QMap: concentrations), optionally perform **P**rincipal **C**omponents **A**nalysis before binning, optionally create bins **Auto**matically instead of fixed size*
	Use clustering method	*Use a cluster method from feature analysis to create phase image*
	Use drawn objects	*Use objects drawn with the tool to determine phases, optionally recycle objects drawn for **Last** analysis*
	Phase detection sensitivity control	*Reduce if found phases are obviously too many*
	Minimum phase area control	*Increase if found phases are obviously too small*
	Enable and control edge cleanup tool	*Use and adjust if phase edges are not well defined.*
	Phase info	*Header of phase list, contains phase name, info on counts in phase, image area covered, SE & BSE contributions, elements and their average content in the phase*

Area	Change area units	
Σ	Merge phases	*Highlight two or more phases with <CTRL> + mouse click and subsequently click Σ to merge to a single phase*

5.2.5.5 Workspace HyperMap

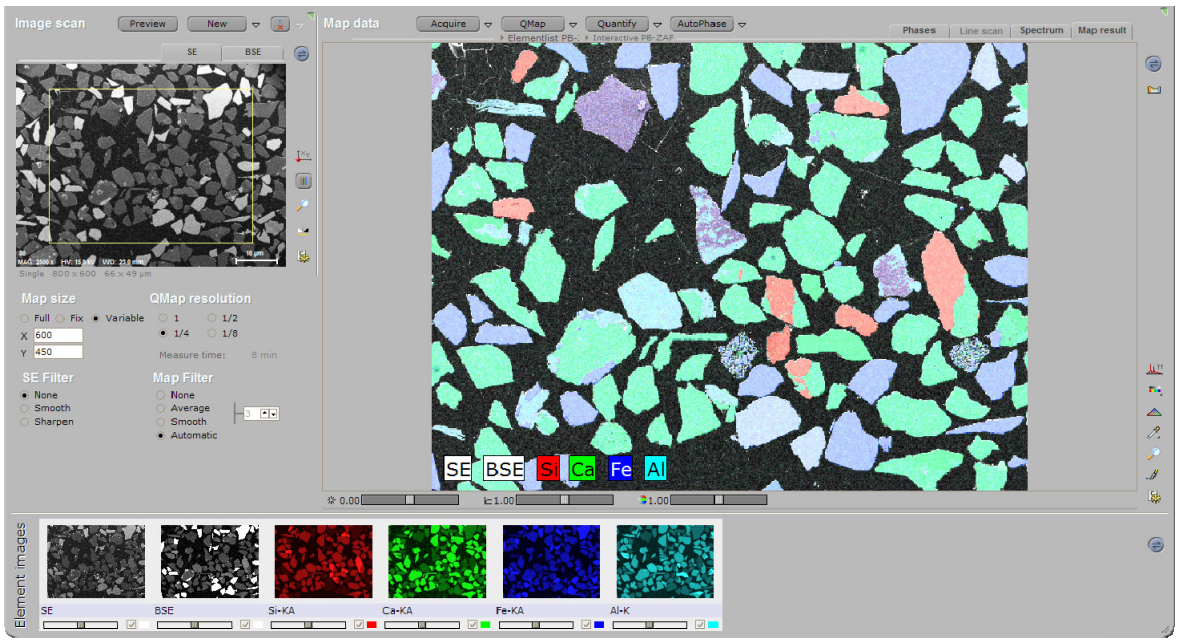


Fig. 5.2-9 The HyperMap workspace with image scan and map window

For a description of the image scan window, refer to section 5.2.4.1. A description of the mapping controls and the map results window as well as for AutoPhase can be found in section 5.2.5.4. For information on the spectrum window refer to section 5.2.3, for information on the line scan window to 5.2.5.3. Actually the HyperMap workspace has only two unique icons:

Object	Description	Hints
	Maximum Pixel Spectrum	*Calculates a synthetic spectrum from the channel maximum values of all spectra in the HyperMap. Useful to determine element traces that may be present in only a single pixel.*
	Show sum spectrum of highlighted phase	*This icon is only visible when the tab* **Phases** *is selected*

5.2.6 Workspace Jobs

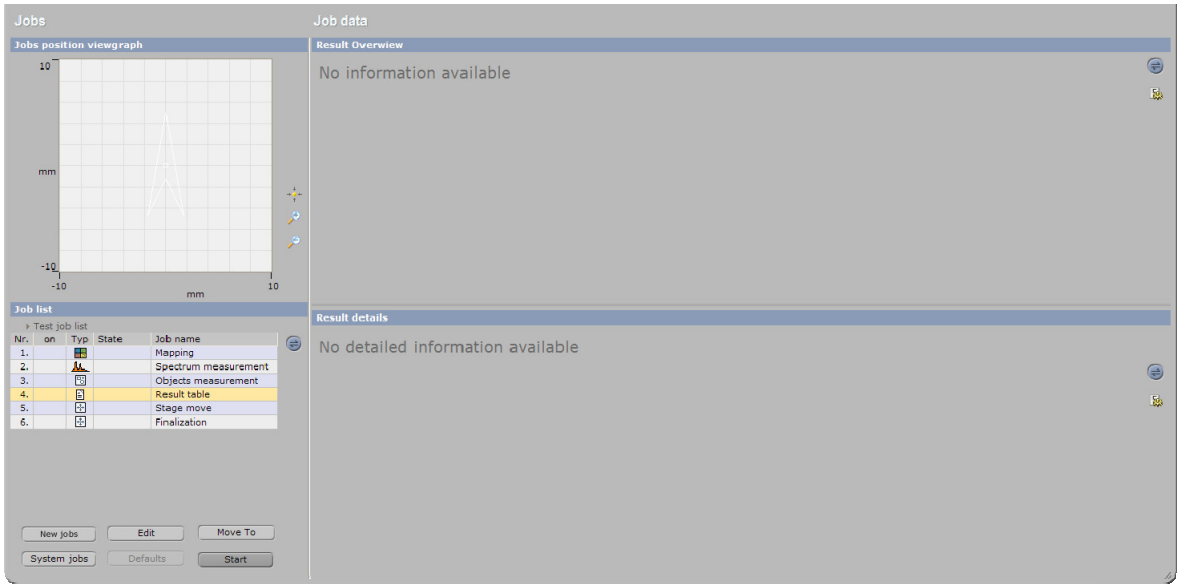


Fig. 5.2-10 The Jobs workspace

Object	Description	Hints
	Center on selected objects	*Moves the selected objects of the job list to the center of the view graph*
	Zoom into view graph Zoom out of view graph	
Test job list	Edit job list name	*During processing of the job list this line also contains the number of the currently processed job and the estimated processing duration left*
No. on Typ State	Job list header	*The header contains job number, whether processing of the according job is enabled (visible through a check mark), job type, state (either* **running** *or* **finished***) and the job name*
New jobs	Add new job	
Edit	Edit job properties	
Move To	Move stage to position of highlighted job	*… and open preview window*
System jobs	Add a system job	
Defaults	Edit the defaults for all job types	
Start	Start / stop job list processing	*Button label changes accordingly*

5.2.7 Workspace Group System

5.2.7.1 Workspace System

Fig. 5.2-11 The System workspace

Object	Description	Hints
System report	Generate system report	
Show	Show license	
Update	Update license	*Required, if additional options have been purchased*
Name	Device name	*Do not change without necessity*
Connection	Device connection	*Do not change without necessity*
Type	Device type	*Do not change without necessity*
Reset	Reset device	
Data	Device data	*Do not change without necessity*
Command	Send low level command to device	*Reserved for service engineer use*
Auto	Auto update device list	

5.2.7.2 Workspace Display

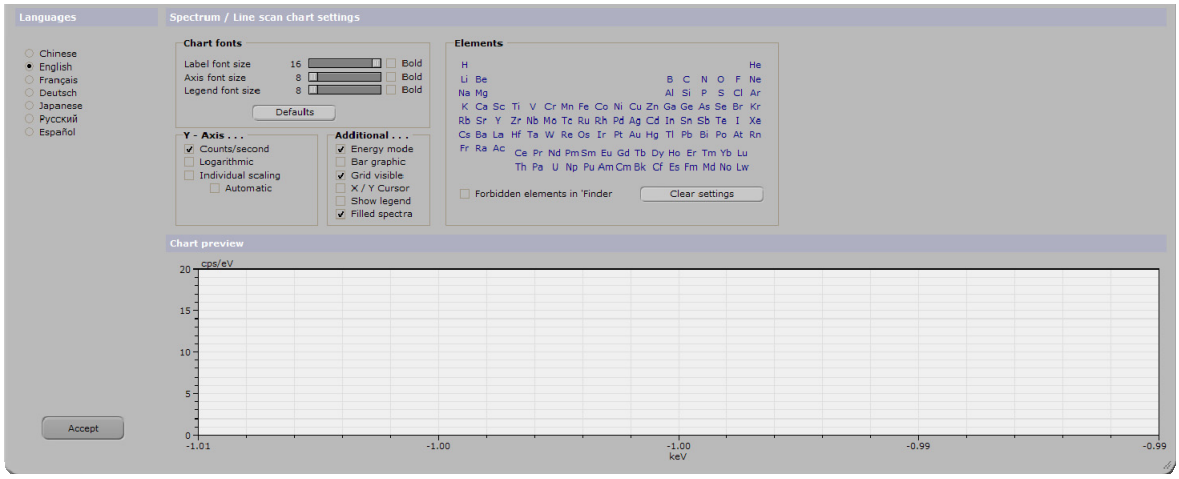


Fig. 5.2-12 The workspace Display

Object	Description	Hints
Chinese	Use Chinese interface	
English	Use English interface	
Français	Use French interface	
Deutsch	Use German interface	
Japanese	Use Japanese interface	
Русский	Use Russian interface	
Español	Use Spanish interface	
Label font size	Set label font size	*Use slide control to set element label font size between 8 and 16 pt., choose bold print if desired*
Axis font size	Set axis font size	*Use slide control to set spectra window X and Y-axes label font size between 8 and 16 pt., choose bold print if desired*
Legend font size	Set legend font size	*Use slide control to set legend font size between 8 and 16 pt., choose bold print if desired*
Defaults	Reset all font sizes to defaults	
☑ Counts/second	Scale spectrum window Y-axis in **cps/ev**	*If off, scaling will be in* **Pulses/ev**
☐ Logarithmic	Logarithmic Y- axis scaling	
☐ Individual scaling ☐ Automatic	Individual Y-axis scaling	*If checked, will accept different Y-axis scaling for every spectrum in the list. If* **Automatic** *is checked, you may right-click + drag the mouse across an area of the spectrum window. All background spectra will be scaled to this region of the foreground spectrum (normalization).*
☑ Energy mode	Spectra window X-axis will be scaled in **keV**	*If off, scaling will be in* **channels**
☐ Bar graphic	Display spectrum as bar graphics	*If off, spectrum will be displayed as line graphics*
☑ Grid visible	Show grid in spectrum window	
☐ X / Y Cursor	Show X-Y cursor	*… instead of line cursor parallel to Y axis*
☐ Show legend	Show spectra names as legends in spectrum window	
☑ Filled spectra	Display solid spectra	*If off, outlines will be displayed*
Mn	Edit element settings	*Clickable periodic table of elements to edit element settings, e.g. line selection*
☐ Forbidden elements in 'Finder'	Add selection to list of forbidden elements	*Forbidden elements will not be identified automatically*
Clear settings	Clear all changes made to element settings	
Accept	Accept all changes made in workspace	*Otherwise changes will be lost*

5.2.7.3 Workspace Spectrometer

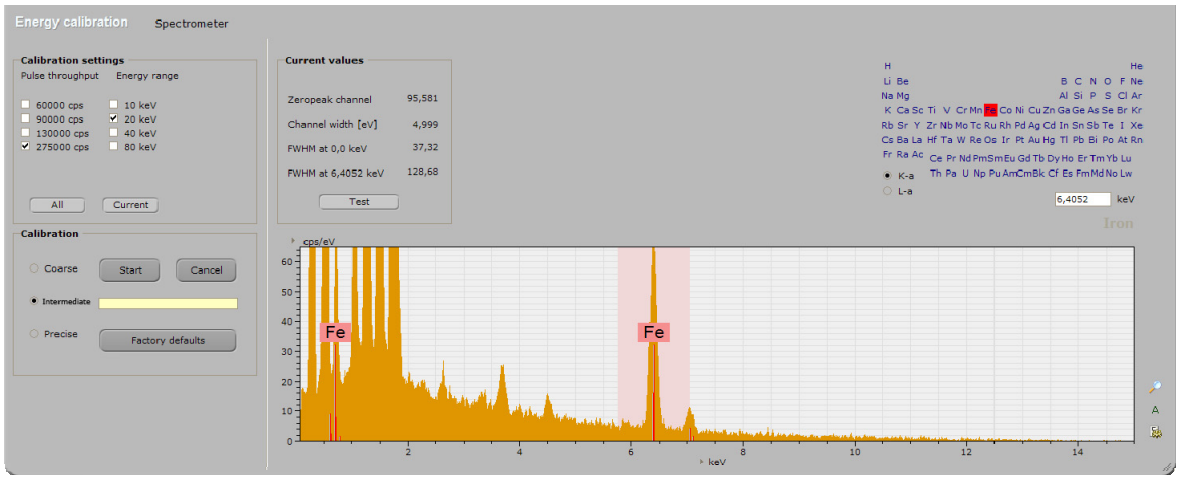


Fig. 5.2-13 The Spectrometer workspace with spectrum window for energy calibration

For spectrum window controls, please refer to section 5.2.3.

Object	Description	Hints
Pulse throughput	Select pulse processor for calibration	*Available are e.g.* **60000 cps**, **275000 cps**, **400000 cps**, *and others. Depending on the configuration of your spectrometer less or other pulse processors may be listed*
Energy range	Select energy range for calibration	*Available are* **10 keV**, **20 keV** *(default),* **40 keV** *and* **80 keV**
All	Calibrate all pulse processor / energy range combinations	
Current	Calibrate the current energy range only	
Coarse	Coarse energy calibration	*Fast but not very precise*
Intermediate	Intermediate energy calibration	*Default, sufficient for most applications*
Precise	Precise energy calibration	*Accurate but time consuming*
Start	Start calibration procedure	
Cancel	Cancel calibration procedure	*Current calibration remains unchanged*
Factory defaults	Reset factory default calibration	
Test	Determine energy resolution for various elements	*Without changing current settings*
Fe	Select element for calibration	*Click on the desired element of the displayed periodic table*
K-a L-a	Select element line for calibration	

5.2.7.4 Workspace Imaging

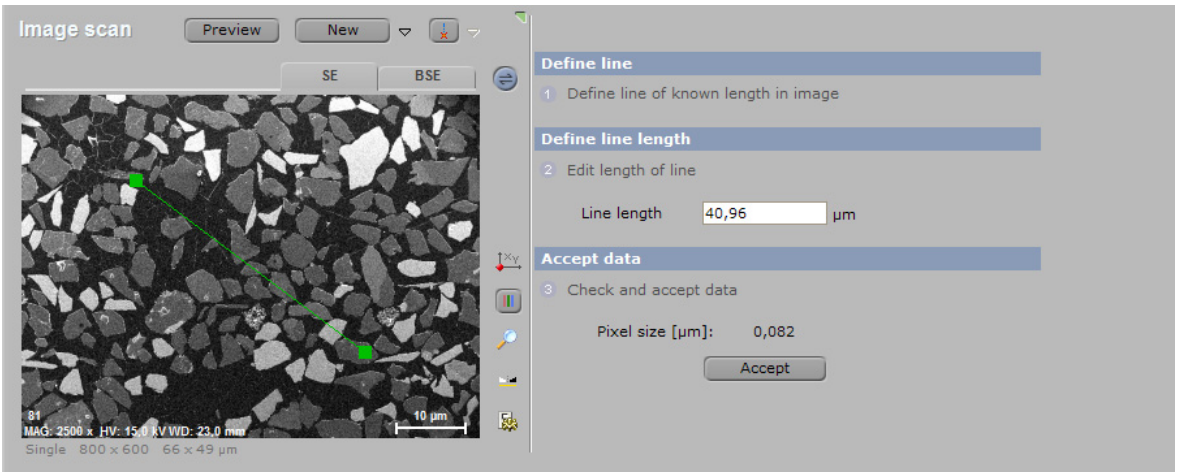


Fig. 5.2-14 The Imaging workspace with scan window for magnification calibration

For information on the image scan window refer to section 5.2.4.1.

Object	Description	Hints
Define line	Define line of known length	*Drag the ends of the line displayed in the image scan window to the desired locations. For maximum accuracy use a SEM calibration grid, set the image scan window to fullscreen display with the icon and draw a line as long as possible*
Line length	Enter line length	
Pixel size [µm]:	Check resulting pixel size	
Accept	Accept new calibration factor	

5.2.7.5 Workspace Microscope

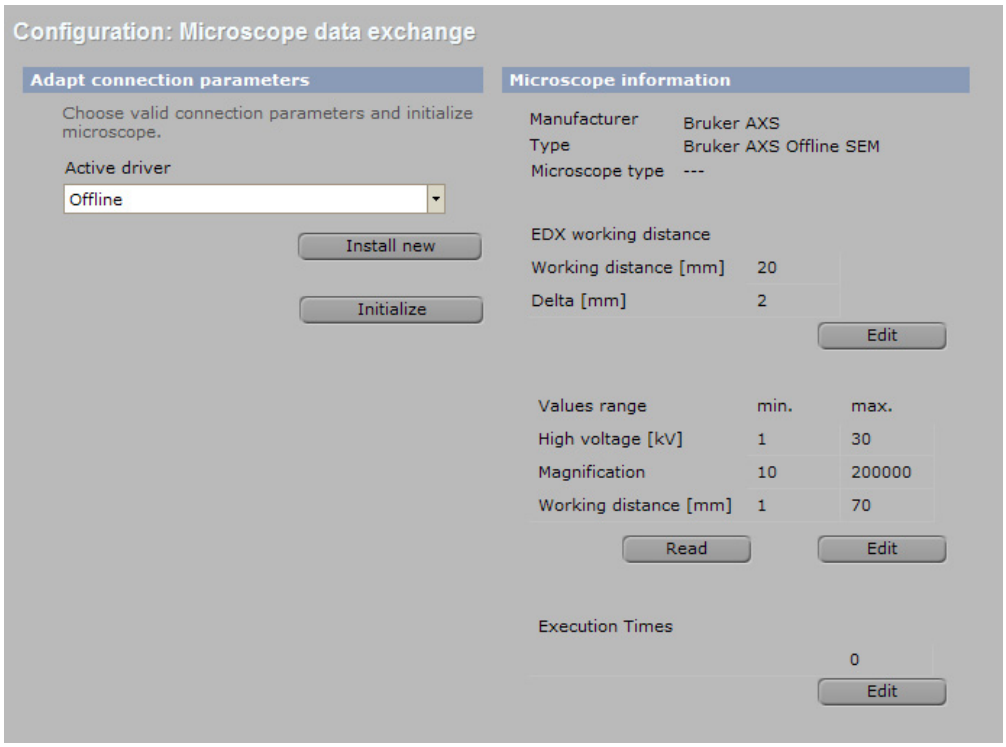


Fig. 5.2-15 The Microscope workspace

Note that all settings in this workspace are normally made during system installation. Moreover, wrong settings will at least lead to a communication failure with the microscope and bear the potential risk of device damage. This description is therefore mainly for educational purposes. Be circumspect when making changes.

Object	Description	Hints
Active driver	Select Active driver for microscope from dropdown list below	
Install new	Install new microscope driver	
Initialize	Initialize microscope	
Edit	Edit working distance	*Edit optimum* **EDS working distance** *and permitted deviation* **Delta**
Read	Read settings from microscope	
Edit		*Set ranges for microscope* **High voltage**, **Magnification** *and* **Working distance**

5.2.7.6 Workspace Stage

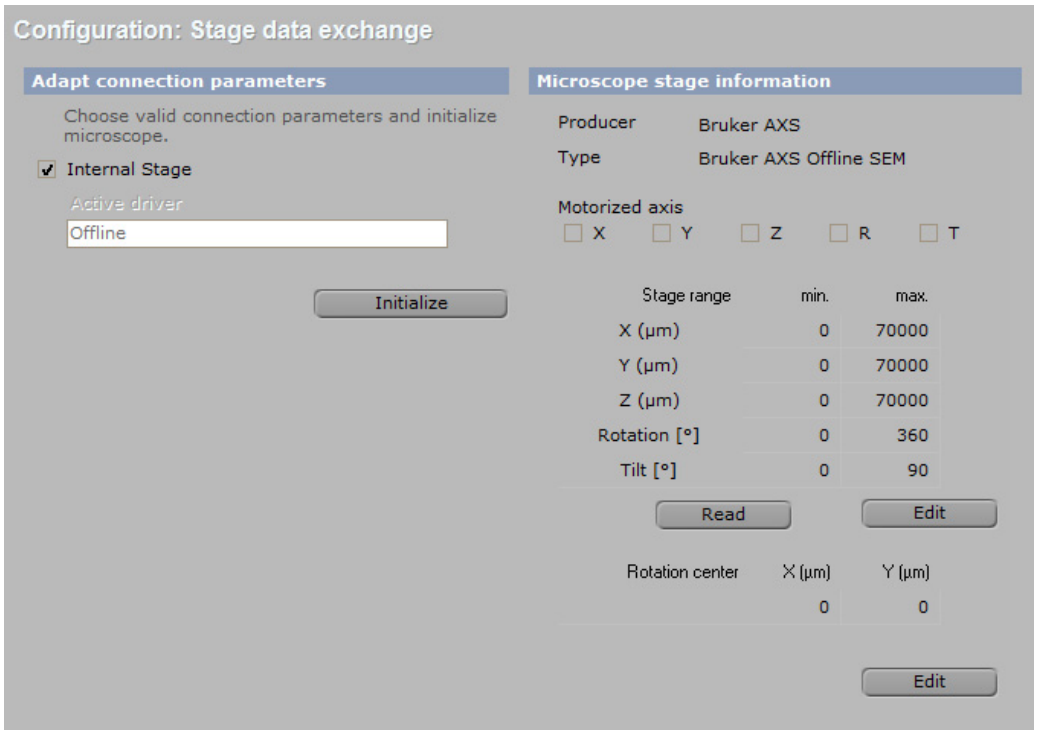


Fig. 5.2-16 The Stage workspace

Note that all settings in this workspace are normally made during system installation. Moreover, wrong settings may bear the potential risk of device damage or at least communication problems. This description is therefore mainly for educational purposes. Be circumspect when making changes.

Object	Description	Hints
Internal Stage	Simulate stage	*Required in demo mode only*
Active driver	Stage driver used	
Initialize	Initialize stage	
Motorized axis	Available motorized axes	*Selectable are* **X**, **Y**, **Z**, **Rotation** *and* **Tilt**
Read	Read stage data from microscope	
Edit . . .	Edit stage data	**X**, **Y**, **Z** *in µm and* **Rotation** *and* **Tilt** *in °*
Edit . . .	Edit rotation center	

5.2.8 Workspace Report

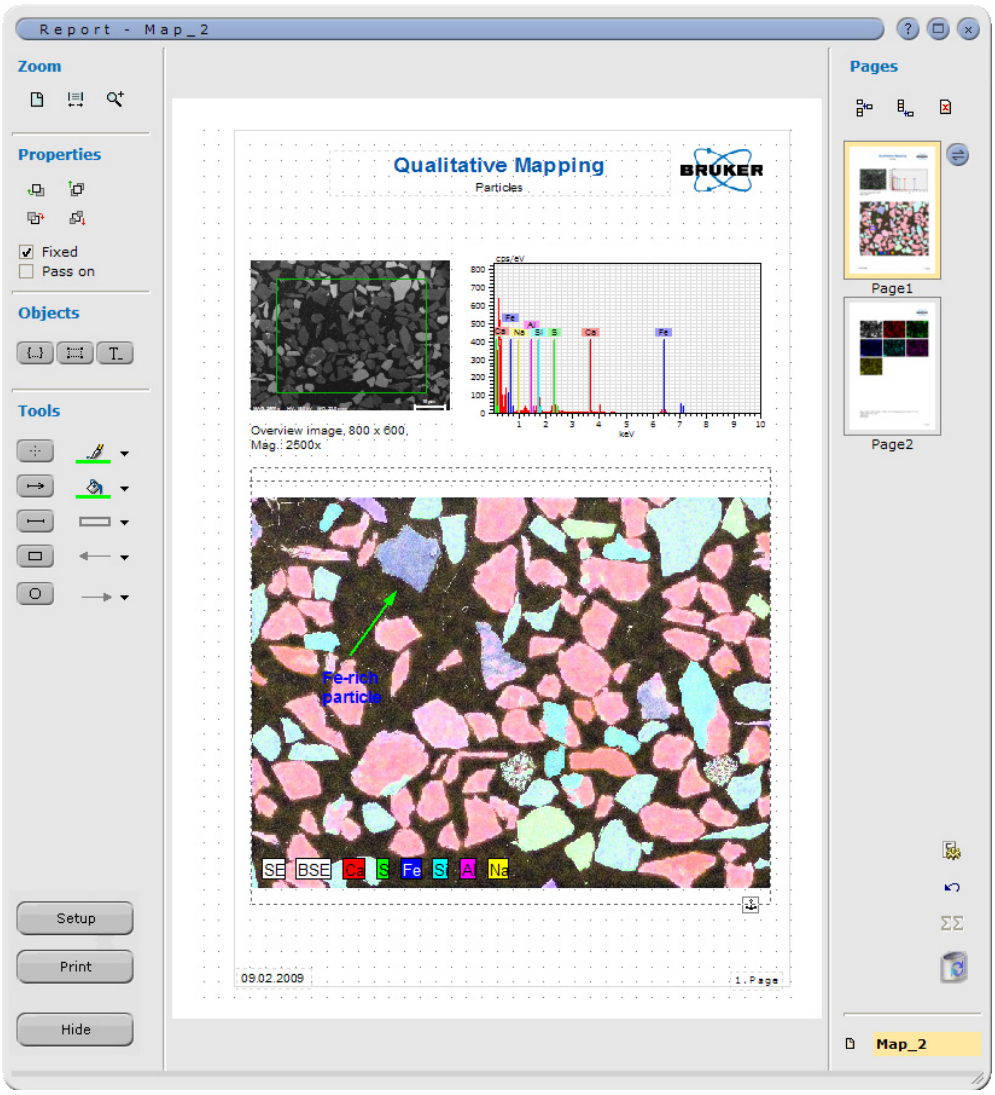


Fig. 5.2-17 The Report workspace

Object	Description	Hints
	Zoom to full page	
	Zoom to window width	
	Zoom in	
	Move object one step forward	
	Move object to top	
	Move object one step backwards	
	Move object to back	
Fixed	Fixed position for selected object	*Cannot be moved or deleted*
Pass on	Copy object to all report pages	*Same position on every page, useful for creating templates*

	Add auto text field	
	Add placeholder	*For later addition of spectra, images, etc.*
	Add text field	
	Draw point	
	Draw arrow	
	Draw line	
	Draw rectangle	
	Draw ellipse	
	Select line color	
	Select fill color	
	Select line width	
	Select arrow style	
	Select arrow head size	
	Page setup for printing	*Uses according Windows dialog*
	Print report	
	Hide report editor	
	Insert page below current	
	Add page at end of report	
	Delete current page	
	Edit report properties	
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